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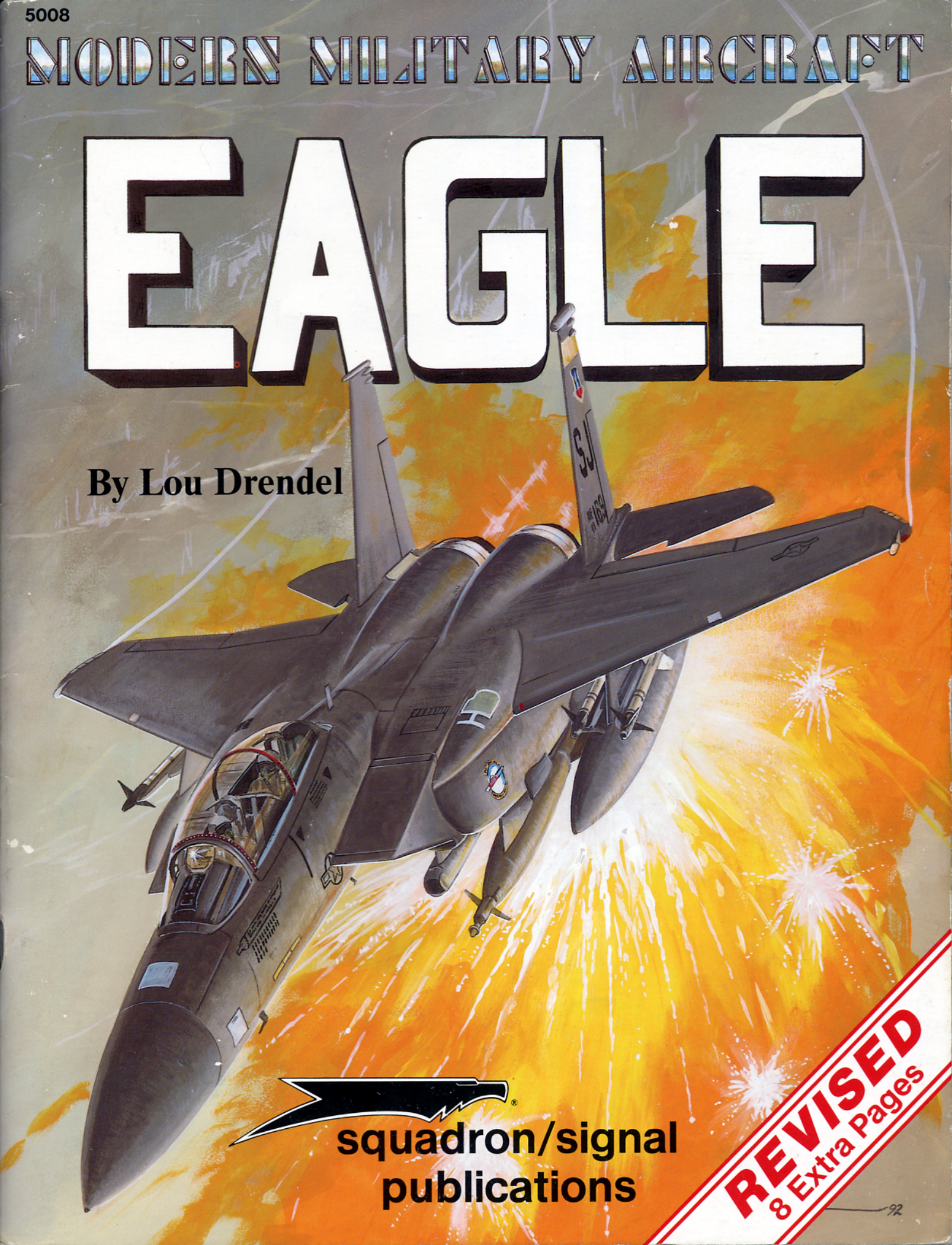
MODERN MILITARY AIRCRAFT

EAGLE

By Lou Drendel



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REVISED
8 Extra Pages

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by Lou Drendel

Color Illustrations by Lou Drendel

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F-15E Strike Eagles of the 4th TFW flew at night during DESERT STORM to hunt down and kill Scud missile launchers and Iraqi supply columns.

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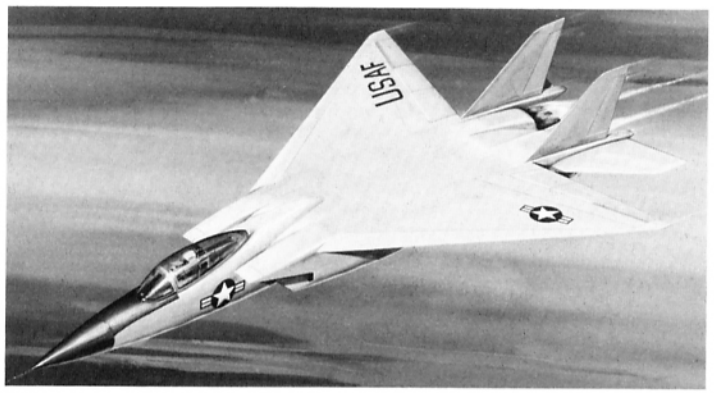
INTRODUCTION

The 1960's were one of the most difficult periods in the history of the American military. They found themselves increasingly committed to a war in the Southeast Asia that American politicians were increasingly unwilling to fully support, and yet were not willing to end. As the war escalated, the Air Force discovered that their airplanes... airplanes that had been designed in the 1950's for all-out nuclear war, left a lot to be desired when it came to fighting a conventional...or in the case of Vietnam, a semi-conventional war.

One arena in which the mission requirements of Vietnam conflicted heavily with the mission capabilities of the aircraft was air superiority. Post World War Two America had been in love with its nuclear sovereignty. Strategic Air Command would keep the peace with its big stick, and if the other guys developed long range bombers, we would knock them out of the sky with missile carrying interceptors. But when it came time to bomb the other guy in North Vietnam, he sent up nimble interceptors to contest the skies. His tactic was to sneak up behind you, then blast away with guns! Guns! Our airplanes didn't even have guns! And if you managed to turn into him, the chances were that you would be either too close to shoot your missile, or have too much angle-off or G for the missile to handle. The envisioned sophisticated radar-directed push-button air war quickly degenerated into an old fashioned dogfight over North Vietnam. Clearly, what we needed was a dogfighter that had the power and agility to outmaneuver an enemy, and the sophisticated avionics to spot and attack him before he could sneak up on you.

There were several people in the Air Force who realized this very quickly once the war in Vietnam settled into a daily grind against tough targets. There were even people who had predicted the need for such a fighter *before* Vietnam. However these ideas were not held in high regard by the Defense Department of Robert McNamara. McNamara and his *whiz kids* were determined to apply the technology of the 1980s to 1960s weapons systems. What the Air Force...and the Navy...needed was a fighter that could do everything! The vaunted TFX would be able to deliver nuclear bombs or napalm. It would be able fight off anything from a MiG to a SAM, and it would do all this from an aircraft carrier as easily as from a 10,000 foot runway. The precept under which all this would be possible was christened 'Commonality' by McNamara. After years of development and billions of dollars, the TFX entered service with USAF as the F-111. The Navy fought long and hard to avoid becoming a TFX customer, eventually winning their battle after McNamara departed DOD. The Air Force managed to develop the F-111 into an outstanding all-weather penetration bomber. It was not, however, by any stretch of the imagination, an air superiority fighter.

Ironically, one of McDonnell's earliest FX concepts contained a feature that would appear on an experimental F-15 over twenty years later. The rectangular exhausts seen on this artist's conceptual rendering can be compared to the Pratt & Whitney two dimensional nozzles described at the end of this book. (McDonnell Douglas)



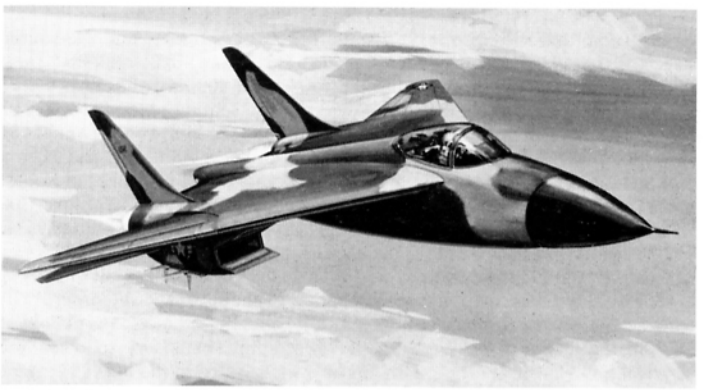
The principal fighter of the Vietnam War was the McDonnell Douglas F-4 Phantom II. The Phantom II had been developed as a fleet air defense interceptor in the 1950s. It was big, ugly, and powerful. Its twin J-79 engines had powered it to several speed and altitude records, and its radar directed fire control system enabled it to engage enemy aircraft beyond visual range. It took two men to operate the Phantom's systems, and it was...and is to this day...one of the most versatile airplanes ever built. It was not designed with a gun, and it was not designed as an airplane to maneuver in a dogfight. It was a Navy airplane that the Air Force had been forced to buy to serve *commonality*. The first Air Force version, the F-4C, was practically identical to the Navy F-4B, it wasn't until the later D and E versions that the Air Force got a Phantom that was designed around Air Force missions.

There were rebels in the Air Force who kept the dream of a pure air superiority fighter alive throughout the McNamara years. They fought hard for Research and Development funds for the *FX*...the fighter experimental. But there were politics involved in keeping the dream alive. McNamara was intent on his airplane for all seasons — the TFX — becoming the be-all, end-all in tactical aircraft. But after the Air Force agreed to buy eleven squadrons of NAVY A-7 Corsair IIs, thereby paying homage to the great God Commonality, he acceded to further funding of the FX as a follow-on interceptor to the Phantom. With that chip in hand, the Air Force Systems Command went overboard in its specifications for the new fighter, finally coming up with a proposed airplane that was uncomfortably F-111 like. However, that was not what the champions of an air superiority fighter had in mind, and they finally made their voices heard.

If any one man could be considered the father of the F-15 it would be Major John Boyd. He had been an instructor at the USAF Fighter Weapons School in the 1950s and had written a tactics manual entitled *Aerial Attack Study*. Boyd had developed theories that went beyond just pulling Gs during a fight. His *energy maneuverability* concepts shaped air combat for the future, taking air-to-air combat out of the horizontal plane and making modern air combat truly three dimensional. Boyd, with the assistance of mathematician Tom Christie, used computers at Eglin AFB to refine his theories and get his conclusions on paper. The resultant report was such an articulate argument in favor of the pure, air-to-air fighter that Boyd was invited to apply his expertise to the design of the FX.

What finally emerged from Boyd's studies was a fighter with high thrust to weight ratio and low wing loading. It was optimised...not to necessarily go high or fast...but to maneuver. That required some rethinking as far as airframe design was concerned. The designers were in love with the swing wing,

This 60,000 lb plus design for the FX competition featured variable geometry wings. It was judged too large and heavy for the air superiority role. (McDonnell Douglas)



and what finally emerged on the Eagle was the simplest of all wing designs, with no leading edge extensions, and two position flaps. The design road from swing wing to fixed wing was not straight and it was not quickly traveled. Similar problems cropped up in the design of the turbofan engines. Turbofans were the wave of the future in the 1960s, but afterburning turbofans would create special problems for their designers.

Boyd had made the acquaintance of another air superiority fighter advocate in Pierre Sprey, who worked in the office of the Assistant Secretary of Defense for Systems Analysis. Together, the two of them became so outspoken in the advancement of their theories that they became known as the 'Fighter Mafia'. The 60,000 pound FX had been pared to 40,000 pounds, but Sprey insisted that it should be lighter still, and the F-15 might have become the first lightweight fighter if it had not been for the Russians. In July of 1967 they provided the first public showing of their Mach 2.9 Mig-25. What the real life and death situation in Vietnam had not been able to do, the public relations coup at Domodedovo did...the FX design was crystallized and a concept formulation study was started by General Dynamics and McDonnell.

The new fighter was formally designated the F-15 when Requests for Proposals (RFP) were released to the industry in September of 1968. McDonnell Douglas, General Dynamics, North American, and Fairchild Hiller responded, and on 30 December USAF awarded fifteen and a half million dollar contracts to all except General Dynamics for project definition. The three com-

The first Eagle, the initial prototype (71-280), nearing completion at McDonnell Aircraft in St Louis. Noticeable prototypical features which were quickly changed are the squared wingtips, straight leading edge on the stabilator, and small speed brake. (McDonnell Douglas)

panies submitted their proposals by the following summer, and the source selection board under Brigadier General Benjamim Bellis applied their criteria to them. The results of these tests were forwarded to Air Force Systems Command where they were analyzed and sent on to the Secretary of The Air Force, Robert C Seamans Jr, who announced McDonnell Douglas as the winner on 23 December 1969. Definition of the F-15 design had been a herculean effort by MCAIR, consuming two and a half million man hours, and over 10,000 hours of wind tunnel tests. During wind tunnel tests over 100 wing variations were tested and as many as twelve models were tested at various wind tunnels around the country. Five times the wind tunnel data was gathered in the F-15 program as had been gathered in the F-4 program.

If John Boyd was the philosophical father of the F-15, then George Graff, who headed the design staff at MCAIR, Bob Little, former chief test pilot and engineer, and Don Malvern, F-15 program manager, spawned the physical item. Their dedication and hard work resulted in the F-15 Prototype (71-0280) being rolled out on 26 June 1972. In July the new fighter was a airlifted by C-5A to Edwards AFB, California, making its first flight on 27 July, with Irv Burrows at the stick. Within the first week the prototype had made four additional flights, totaling 288 minutes, at speeds of up to Mach 1.5 and altitudes to 45,000 feet.

By the middle of September 71-0280 had accumulated over forty hours of flight time by McDonnell test pilots Peter Garrison and Irv Burrows. and was turned over to the USAF F-15 joint test force, headed by Lt Col W H Shawler. The joint test force was made up of thirteen pilots, seven from TAC and six from AFSC. Because of advanced instrumentation that recorded data on 700 parameters, the flight test program advanced more rapidly than comparable programs on the F-101 Voodoo or F-4 Phantom II.

The initial contract allocated Twenty pre-production F-15s to the test program. Category I testing, which included Contractor Development, Test and Evaluation, was allocated ten F-15A single seat airplanes (71-280 to 71-286 and 71-287 to 71-289), and two two-seat TF-15s (72-290 and 72-291 which would later be redesignated F-15Bs). A further eight single seaters (72-0113 to 72-0120) were produced for Category II testing (Air Force Development, Test, and Evaluation) and III testing (Follow-on Operational Test and Evaluation). Production of the first eleven airplanes was completed by the end of 1973.

The extensive wind tunnel testing paid off in a relatively smooth test program, marred only by the the stubbornly recalcitrant turbofan engines. Changes to the airframe included the removal of four square feet of wing

(Below and Right) Irv Burrows, McDonnell's Chief Test Pilot, dismounts from 71-280 after taking the Eagle up for its first flight on 27 July 1972. Twelve years later he was reunited with the first Eagle, which is now relegated to serving as an Air Force recruitment tool as it is hauled around the country on a truck. Burrows is currently serving as MCAIR Vice President for plans and operations, and took the time to renew his association with the historic Eagle when it came to St Louis during the summer of 1984. (McDonnell Douglas)

(Above) The first F-15 in block two was Eagle Number Three (71-282), and is seen over the California desert during an early test flight in overall Gray trimmed in bright Yellow. (USAF)

area from the tips to alleviate buffeting, and cutting a step into the leading edge of the stabilators to solve flutter problems. The speed brake was made more effective by increasing its size by fifty-seven percent. Those were the easily recognizable exterior changes. More than thirty changes were made internally to make the Eagle more maintainable and reliable.

The radio controls were moved from the right or left console position that they had occupied in almost all other jet fighters to a position directly in front of the pilot, just below the top of the instrument panel glare shield lip. The IFF/transponder is in the same stack as the radios.

While the switchology makes it possible for the pilot to keep his eyes outside the cockpit, it is the large canopy that provides the pilot with the opportunity to eyeball 360 degrees (it is possible to see the port vertical stabilizer by looking over your right shoulder). The pilot sits high in that bubble, and there are only two canopy bows to obstruct the view. The canopy comes all the way down to the pilot's waist, so it doesn't take much to roll up on a wing and look straight down.

During the test program it was inevitable that the Eagle would be compared with it's forerunner, the Phantom. The F-15 is a foot longer and has four feet more of wing span than the F-4, but weighs in at only eighty percent of the F-4's loaded combat weight. The F-15 has twenty-five percent more wing area than the F-4, which gives it a combat wing loading, with sixty percent of its internal fuel load remaining, of 58 psf compared to 80 psf for the Phantom. Though its performance is light years beyond that of the Phantom, the Eagle is less complex and consequently, much more easily maintained. The chart below illustrates the complexity gap between F-15 and F-4E.

SYSTEM	F-4E	F-15
COCKPIT INSTRUMENTS	48	30
LUBRICATION POINTS	510	202
HYDRAULIC FILTERS	21	7
AVIONICS BLACK BOXES	294	106
ELECTRICAL CONNECTORS	905	808
FLIGHT CONTROL DEVICES	16	9
FUEL SYSTEM CONNECTIONS	281	97

The left and right engines of the Eagle are interchangeable, and maintenance crews have demonstrated engine changes in less than twenty minutes. There are 300 percent more access panels on the F-15. A man can stand upright under it's wings, and the series of built-in-test (BIT) units contribute to maintainability which cuts the maintenance man hours per flight hour in half compared to the Phantom. In addition, the F-15 is more reliable,

(Above) The fourth Eagle (71-283) was equipped with an instrumented nose probe and the McDonnell developed EROS collision avoidance pod. (McDonnell Douglas)

(Below) The seventh Eagle (71-286) was painted in the ineffective and short lived air-to-air camouflage scheme of overall Air Superiority Blue, which stood out under all atmospheric conditions. (McDonnell Douglas)

(Below) 71-286 remained in the test program for several years. It is painted in Air Superiority Blue with Yellow trim on the tail and intake, and red trim around the canopy and nose probe. (Wally Van Winkle)

with a MTBF (mean time between failure) rate of 5.6 hours, compared to 1.3 hours for the Phantom, which contributes to overall safety, with a major accident rate of eight per 100,000 flight hours, versus 14.5 for the Phantom. Combat turn around time for the F-15 is twelve minutes, which is forty-five percent quicker than the Phantom.

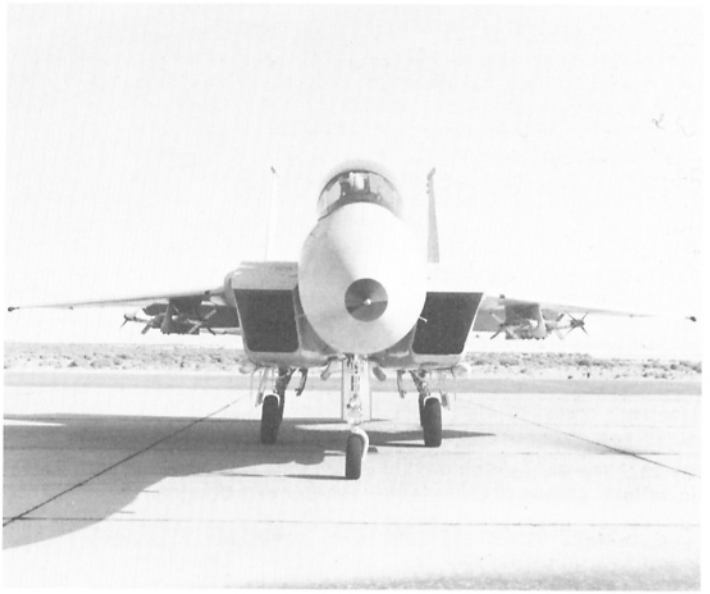
The Air Force was involved in the test program virtually from the beginning, and this resulted in all but two of the thirty-five recommended changes being incorporated in the first production airplane, which was the twenty-first Eagle to roll out of McDonnell Douglas. This can be compared with the 135 recommended changes incorporated in the first production Phantom, which was number forty-eight to roll out of McDonnell Douglas. Production time for the first F-15 Eagle was 11,000 man hours, while the first F-4 Phantom required 35,000 man hours.

But perhaps the most dramatic feature of the F-15 program was its adherence to projected costs. The two Air Force Generals responsible for this were Benjamin N Bellis and Robert C Mathis. They insisted upon complete documentation and definition of any changes, even down to accounting for who paid for joint Air Force/Contractor lunches! Mathis was particularly sensitive to the possibility of any charge of collusion, having had to clean up after the politically complicated F-111 program. The result was an F-15 program so clean that, even in the witchhunt 1970s, there were no blemishes on the F-15 program. I recall talking to Navy people who had suffered through the teething problems of the F-14, who spoke with frank admiration about the manner in which the Air Force had run its F-15 program. When the Navy admits to admiration for the Air Force, that's HIGH praise!

71-287 was the Eagle which did most of the spin testing. It was equipped with a parachute canister on top of, and between the engines, and was painted overall White, with Red Orange trim. (McDonnell Douglas)

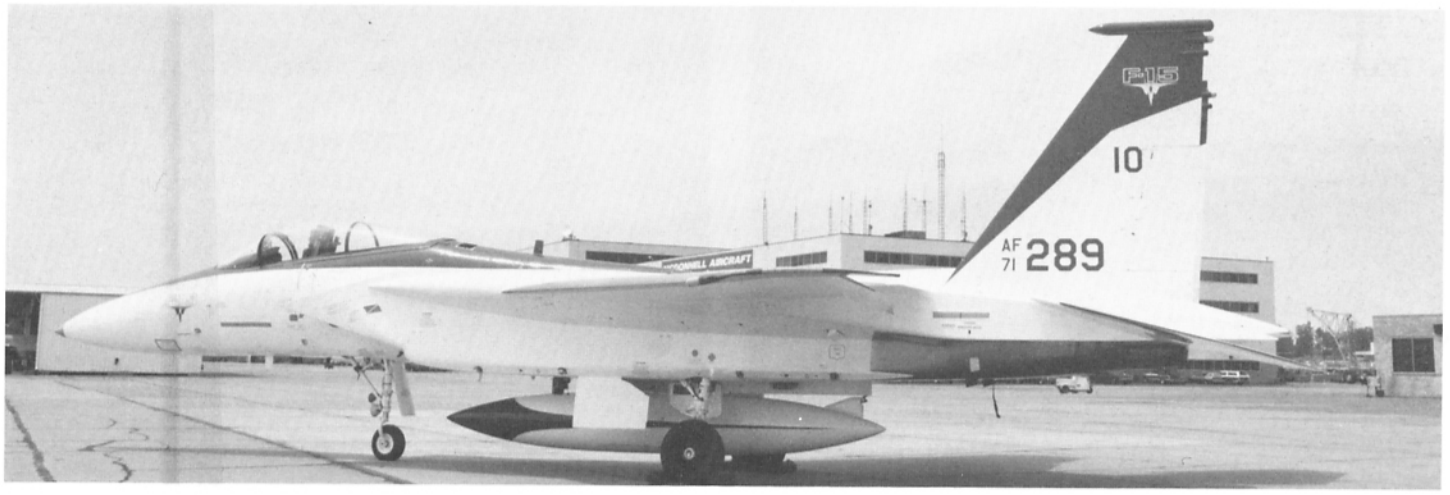
Although it was developed as the best air superiority fighter ever built, even before it entered service the Eagle was being touted for the air to ground role. In April of 1974, *Aviation Week & Space Technology* reported that MCAIR engineers were claiming that the F-15's primary mission would not be compromised in any way by incorporation of the bombing mission in its operational profile. They maintained that the F-15's low wing loading and high energy maneuverability provided the capability to carry heavier loads than the F-4, while still retaining the ability to maneuver to avoid anti-aircraft fire. The same load-carrying capability allowed the Eagle to carry Sparrow and Sidewinder missiles on bombing missions.

As the Eagle was readied for squadron service, reports from its test pilots indicated what a quantum leap in fighter design the F-15 embodied. Switchology in the single seat fighter has always been critical, and in the jet age, where targets must be acquired and tracked visually at greater distances than ever before, it is even more important for the pilot to be able to keep his eyes out of the cockpit. In the F-15 that concept is catered to in all of the attack aspects. The primary radar scope control switches are located on the throttles and flight control stick, so that the pilot can easily go from scope to visual reference without searching for switches. The radar modes used in conjunction with the heads-up display (HUD) are located on the stick grip. Weapons selection switches for Sparrow, Sidewinder, or guns are located on the throttles. When the weapon is selected, the HUD display changes automatically to the proper guidance symbology for that weapon.



(Right) F-15A with a full air-to-air weapons load of four AIM-7 Sparrows and four AIM-9 Sidewinders. Its narrow landing gear track and high wing makes the F-15 a handfull in crosswind landings. (McDonnell Douglas)

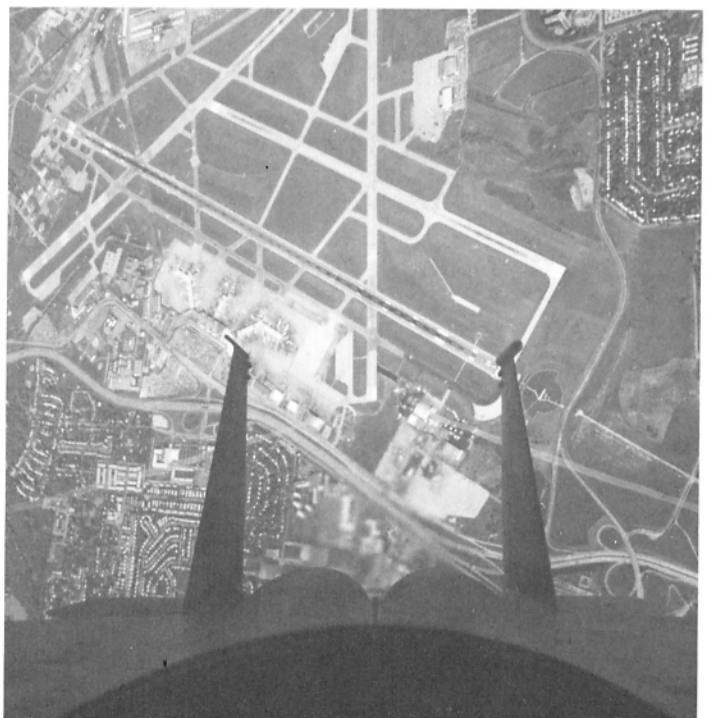
Number ten F-15A (71-289) is currently finished in overall White with Blue trim including the centerline tank. (McDonnell Douglas)



The current principle armament of the F-15 is the AIM-7 Sparrow (on the fuselage stations) and the AIM-9 Sidewinders (on the wing pylons). (McDonnell Douglas)

By 1977 the production facility at St Louis was crowded with Eagles in various stages of completion. (McDonnell Douglas)

To accommodate the capability of the Eagle to accelerate in a vertical climb, the FAA has initiated the 'Viking Departure' at Lambert Field, St Louis, the home of McDonnell Aircraft Company. This over-the-should view of Lambert Field was taken from the rear cockpit of an F-15 during a Viking Departure. (McDonnell Douglas)



STREAK EAGLE

Until the advent of the Pratt & Whitney F-100 engine, the *big mama* of thrust producers was the mammoth General Electric J-75 turbojet, which powered the F-105 and F-106. The J-75 produced 24,500 lbs of thrust in afterburner, weighed 6,000 lbs, and was nearly twenty feet long and three and a half feet wide. The F-105 had a maximum takeoff weight of 54,000 lbs, the F-106 35,000 lbs, and each was powered by one J-75. The F-15 is powered by two F-100s, whose combined weight is only 6,000 lbs. Each F-100 engine produces 24,000 lbs thrust and is only sixteen feet long. The F-15's maximum takeoff weight is 56,000 lbs, but with full internal fuel and four Sparrow missiles it only weighs in at 41,500 lbs, providing a thrust to weight ratio exceeding one to one. It was only natural that the F-15 be used to set new records. The engineers at McAir had done computer projections that indicated the F-15 would *easily* establish new rate of climb records.

In January of 1975 three Air Force pilots broke all of the existing time to climb records previously held by a Navy F-4B and the Russian MiG-25. The airplane they used was a modified F-15A (72-119, the nineteenth production aircraft). The modifications made were primarily weight saving deletions of equipment not necessary to the record flights, and included the gun, radar, selected avionics, tail hook, one generator, utility hydraulic system, flap and speed brake actuators, and...the external feature that made Streak Eagle distinctive...the paint. Elimination of the paint only saved forty pounds, but its deletion served notice to everyone who saw the Streak Eagle that these were serious record attempts.

It was necessary to add some specialized equipment to the Streak Eagle for these record attempts. In order to obtain maximum acceleration, the Air Force wanted to be able to run the engines up to full power prior to starting the record attempt. And while the brakes would lock the wheels, the power of the engines was enough to easily overcome locked wheels and just slide the Eagle down the runway, leaving smoking rubber streaks behind. A holdback cable catch was installed in place of the tailhook. Battery packs were installed because the engines would be shut down above 80,000 feet. An instrumented nose probe was also installed, as well as a sensitive accelerometer, an over the shoulder camera, a standby attitude gyro, and a battery powered radio. Even with ballast added for proper weight and balance, the Streak Eagle weighed in at 2,800 lbs less than the standard production F-15. On each record flight only enough fuel was carried to set the record and return to base.

Major Roger Smith set the 3,000, 20,000, and 30,000 meter records. Major W R MacFarlane flew one record flight in which he set records to 6,000, 9,000, and 12,000 meters, and Major D W Peterson set the 15,000 and 25,000 meter records. The record attempts were flown from Grand Forks, North Dakota in the middle of winter, and standard temperatures were necessary to insure optimum performance. All of the record flights required extraordinary airmanship. The lower profiles were tricky because the Streak Eagle accelerated so fast, once the explosive bolts released the holdback, that the 350 knot limit on landing gear transition could quickly be exceeded. The pilots had to rotate and raise the gear at the first indication of airspeed on the airspeed indicator. This was at about 70 knots, and would occur at three to four seconds after holdback release! While severe clear weather was required for the flights, they were actually flown almost entirely on instruments. The 30,000 meter (98,425 feet) profile is a good example of why the instruments had to be the primary visual cues.

The flight profile, in Major Roger Smith's words:

> *Release from the holdback cable at full afterburner with 7,000 lbs of fuel. Gear up and rotate for takeoff at the first indication of airspeed, about seventy knots. Watch the gear unsafe light and hope it goes out by 350 knots. If not, abort fast. Look for 0.65 Mach — about 420 knots. Rotate vertically into an Immelmann and hold 2.65 Gs. Expect to arrive level upside down at 32,000 feet at 1.1 Mach. Roll 180 degrees to right side up and accelerate to 600 knots. Climb at eight degrees to 36,000 feet at 600 knots. Hold 36,000, accelerate to 2.25 Mach, pull four Gs to fifty-five degrees (it took 60 degrees because of a strong tailwind). Look for four degrees angle of attack. Hold four degrees until Pete Garrison (MacAir chief test pilot and the voice of mission control.) calls to recover (passing the required 98,425 feet). Shut down afterburners when they blow out. Shut down engines when they quit (somewhere above 80,000 feet). At the 'recover' call, try to hold zero angle of attack to minimize any tendency for control or gyroscopic unknowns to the flight path in the rare atmosphere. Ride ballistically to a fifty-five degree dive angle. Look for 100 knots airspeed and start turning for home — if you can figure out where home is on the snow-covered terrain without a compass.*

> *At 55,000 feet or below, look for four green lights on the instrument panel to indicate the boost pump is on. Try to start both engines at once when above 350 knots and twelve percent rpm. If at least one starts and you have radio contact with Pete Garrison, talk about coming home to Grand Forks, depending on fuel remaining. If there is no start or no contact on radio, think about Fargo or ejection.*

It was a complicated flight profile, made more demanding because the tremendous acceleration of the Streak Eagle condensed it into less than three and a half minutes. Add to that the fact that the records to altitudes above 50,000 feet had to be flown with the cumbersome pressure suits on, and you can see why it took pilots with intense concentration and facile reflexes to fly them. All of the profiles were verified with computer projections and flown extensively in simulators. But simulators cannot duplicate the tactile sensations of breath taking acceleration, and the need to hold precise G in a maneuver while controlling unprecedented power. (The Streak Eagle could outclimb the Apollo Moon rocket to 60,000 feet!)

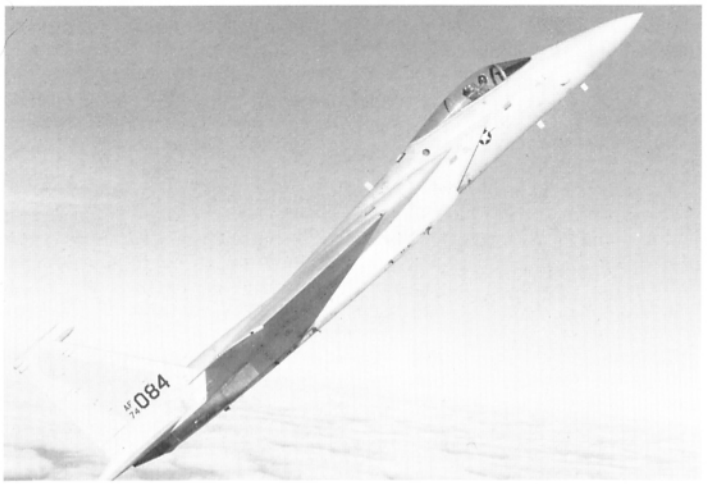
The record flights were more than just jingoistic exhibitions of American technological superiority. They spotlighted some design flaws in the F-15, which led to changes in operational Eagles. These ran from redesign of the ejection seat handle to accommodate the gloved hand of a pressure suit, to lowering of the cockpit pressurization seals in order to maintain cabin

McDonnell Chief Experimental Test Pilot Pete Garrison (left) did much of the preliminary flight testing which led to the Streak Eagle records set by Air Force pilots Willard Macfarlane, Roger Smith, and Dave Peterson (left to right). (McDonnell Douglas)

pressure when flying at Mach 2.2 and making a 5 G pullup, to development of a new inlet schedule for the variable-geometry engine inlets to improve supersonic performance. Changes in the fuel flow system prevented flameouts in low fuel conditions, and it was discovered that an earlier fix to overcome a lag in the second stage turbine temperature sensor resulted in a six to eight percent increase in acceleration at speeds greater than Mach 1.8.

Jingoism was at the heart of the Russian response to the Streak Eagle records. Within a few months of the F-15 record flights, the Russians claimed time to climb records of 2 minutes 34 seconds to 82,000 feet, 3 minutes 10 seconds to 98,400 feet, and 4 minutes 11 seconds to 114,800 feet. The records were supposedly flown in the E266, an experimental version of the MiG 25, on 17 May, 1975. Since the Soviets do not invite representatives of the FAI (Federation Aeronautique International), the certifying agency for all record flights, to view their attempts, it is not always easy to verify Russian claims. Though these records stand, examination of the flight profiles by engineers would seem to indicate that if they were flown, they were flown with rocket assistance.

The Streak Eagle was a modified F-15A (72-119). It set a whole new set of time-to-climb records and was eventually retired to the Air Force Museum at Wright Patterson AFB, Ohio, where it is painted in the standard Gray camouflage scheme. (McDonnell Douglas and USAF)



(Above) The dominance of McDonnell Aircraft Company is embodied in the still popular F-4 Phantom, and the F-15 Eagle refueling from a KC-135 of the 126th ARW, Illinois Air Guard. (McDonnell Douglas)

(Left) With a power to weight ratio of better than one to one the F-15 will climb comfortably at this angle in military power. (McDonnell Douglas)

(Below) One of the most well traveled Eagles (71-291) was the second two seater pre-production prototype. Built under the designation TF-15 it was later re-designated an F-15B. It was retained by McDonnell for test work, and has carried out most of the testing for company proposed enhancements. Seen here in its original Air Superiority Blue paint scheme during an early test flight. (McDonnell Douglas)

INTO SQUADRON SERVICE

The first production F-15 Eagle was TF-15A-7-MC, serial number 73-108, a two seat 'tub', which was later redesignated F-15B. It was delivered to the 555th Tactical Fighter Training Squadron (TFTS), 58th Tactical Fighter Training Wing (TFTW) at Luke AFB on 14 November 1974. The importance of the F-15's inaugural can be measured by the fact that on hand for the occasion was the President of the United States, Gerald R Ford. Within a few weeks F-15s appeared in increasing numbers at Luke, as the other squadrons of the 58th TFTW, the 461st and 550th got their Eagles and began training Eagle flight instructors and ground crewmen. The 58th TFTW was subsequently redesignated 58th Tactical Training Wing (TTW) in 1977, and then 405th Tactical Training Wing in 1979. Its name was changed. But its mission remained the same. Still operational, it is the only lead-in F-15 training wing in the Air Force, and now comprises four training squadrons.

The first F-15 combat wing was the 1st Tactical Fighter Wing (TFW) at Langley AFB, Virginia which began receiving its Eagles in January of 1976, and was operational before the end of the year. The second wing equipped with Eagles was the 36th Tactical Fighter Wing of USAFE stationed at Bitburg Air Base, in the Federal Republic of Germany, becoming operational during 1977. On 20 December 1977, six F-15s flew over Holloman AFB, NM, led by four Phantoms from the 49th TFW. This symbolic fly-by signalled the 49th's transition from the the F-4 Phantom II to the F-15 Eagle, effective that date.

The 57th Fighter Weapons Wing, at Nellis AFB, Nevada also received fourteen Eagles in 1977. The Nellis Eagles were assigned to the 433rd Fighter Weapons Squadron, whose job it was to train F-15 *Tactics Experts* for each of the operational squadrons. The instructors at the 433rd would continue Follow-on Operational Test and Evaluation of the Eagle, while at the same time developing the tactics which would enable USAF to exploit the F-15's tremendous potential most effectively. These tactics were then passed down to the operational level through the graduates of the Fighter Weapons School.

The highlight of OPERATION CORONET SANDPIPER was the arrival of the first Eagles to Camp New Amsterdam (Soesterberg) AB in the Netherlands on 13 September 1978. It was the inaugural of a new USAFE Eagle unit, the 32nd TFS. The following December, the 33rd Tactical Fighter Wing at Eglin AFB, Florida began receiving their Eagles. In January of 1979, twelve F-15s from the 94th TFS of the 1st TFW deployed to Saudi Arabia to demonstrate the Eagle to the Royal Saudi Air Force, which had just ordered sixty F-15s. The first PACAF unit to equip with the F-15 was the 18th TFW, at Kadena AB, Okinawa, receiving their Eagles in September, and completing their transition from F-4s in late 1980.

While introduction of the F-15 Eagle into regular squadron service went extremely smoothly, it was not without its glitches. The major problem being the Pratt & Whitney F-100 engine. The P&W F-100 engine had won out in a competition with General Electric, which was producing the J-79 engine for the F-4. Pratt & Whitney had been at the forefront of advanced engine development, having developed the J-58 for the SR-71, and versions of the TF-30 engine used in both the F-111 and F-14 (both of which had suffered teething problems). The F-100 engine produces nearly eight pounds of thrust for each of the engines 3,000 pounds, but in the process generates compression ratios of 23:1 and turbine temperatures of 2,500 degrees. The major problem encountered with the F-100 engine was stall/stagnation, which degenerated into compressor stalls, caused by slow speeds at high altitudes, large and/or quick throttle excursions, or high angle of attack maneuvers. And since these maneuvers are a litany of normal air combat, compressor stalls became more than a casual problem — a problem which seemed to defy solution. The engineers at P&W finally did come up with solutions, which included changing afterburner settings when the stall was sensed and reducing afterburner fuel flow to minimum while opening the afterburner nozzle (this was done automatically). These fixes had the effect of slowing the hemorrhage of confidence which had resulted from decreased rates of readiness, and the attendant consequence of Congressional hearings.

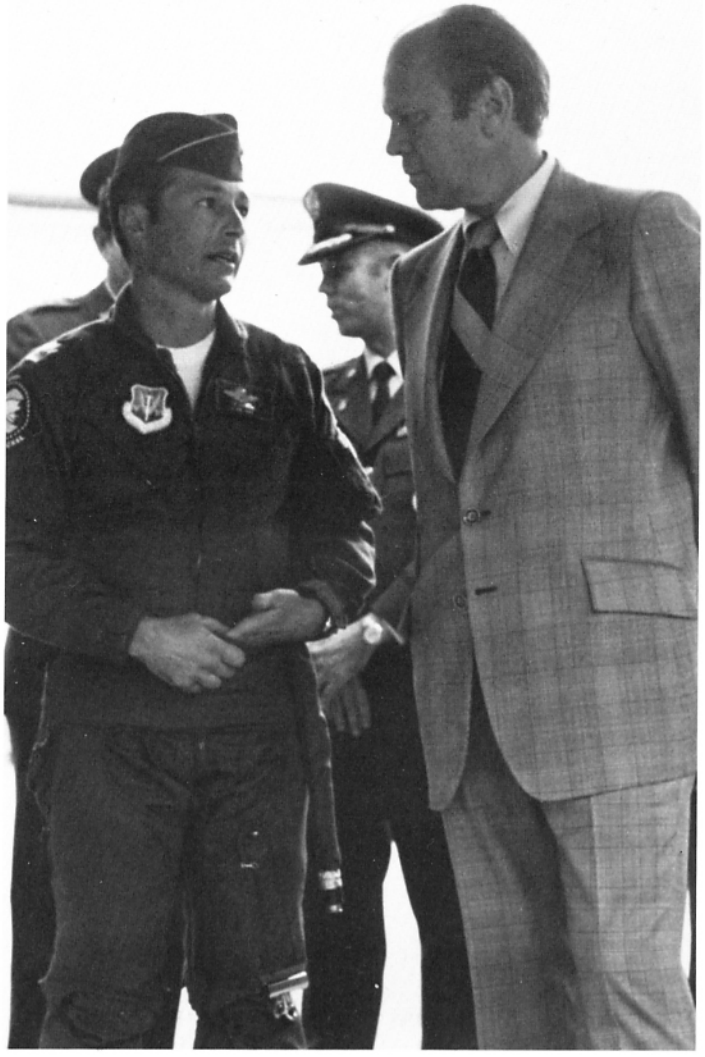
Other problems which cropped up as a result of the stall/stagnation problem centered around engine fatigue and greatly reduced engine component life. Production engines were trimmed to operate at lower temperatures, and the time required to trim an engine was lowered from twenty-two minutes to one minute! But as if these problems were not enough, just as the F-100 engine was being redeemed, unions at two of the parts suppliers went on strike, creating an instant shortage of some of the most critical components of the engine. General Alton D Slay, Commander of Air Force Systems Command, spent days in front of the Senate Armed Services Committee explaining the reasons for degraded F-15 readiness rates. General Slay recommended several changes in future engine procurement procedures, but was unstinting in his praise of the P&W F-100 engine, stating that he had never seen an operational jet fighter engine brought into the inventory without troubles, and that the F-100 engine was what made the F-15 and F-16 the highest performing fighters in the world.

As the F-100 engine became more reliable, the attention of the operational units turned to tactics. By 1981 USAFE was concerned that the increasing numbers and technological sophistication of the Warsaw Pact threat would overwhelm NATO unless a new generation of air-to-air missiles was developed. While some defense critics were claiming that the radar missile was inherently unreliable, citing the poor performance of the Sparrow missile, when compared to the Sidewinder, the pilots who would have to fly against the threat in Europe were anxiously awaiting introduction of AMRAAM (Advanced medium-range air-to-air missile). The need for an advanced radar homing air-to-air missile is acute in a scenario where visual identification of targets would be difficult at best, because of weather, and probably not even desirable because of a tactical situation that would see NATO fighters greatly outnumbered. In that kind of scenario, it would be critical to be able to turn as soon as you have launched your missile, because there is a good chance that someone will be turning into your six o'clock.

The AMRAAM will begin to enter operational inventories of both the Navy and Air Force in 1985, and will eventually supplant the AIM-7 Sparrow. Though approximately the same size as the Sparrow, AMRAAM can be launched from rails (ala Sidewinder) or ejected. It can be fired within eyeball range using simple boresight modes, and active radar guidance homing. Out Beyond Visual Range (BVR) three modes of guidance will be used; inertial guidance will be supplied by the launching aircraft during the first phase, being replaced by autonomous guidance, and finally, active radar guidance as AMRAAM approaches its target. The F-15 will be able to carry six AMRAAMs.

In 1979 the improved single seat F-15C and F-15D versions of the Eagle

F-15A of the 58th Tactical Fighter Wing (TFW), 555th Tactical Fighter Training Squadron (TFTS) at Luke AFB, Arizona in March of 1976. (Arnold Swanberg via Jerry Geer)



(Above) The first operational Eagle was delivered to the 555th Tactical Fighter Training Squadron at Luke AFB, Arizona on 14 November 1974. 555th CO, Lt Col Ted Laudise explains a performance feature to President Gerald Ford during the welcoming ceremony. (USAF)

(Above) F-15A of the 555th TFTS as it appeared at Luke AFB in March of 1975. This is a block seven aircraft, and still carries the Air Superiority Blue paint, as well as the speed brake stiffener. (Arnold Swanberg via Jerry Geer)

(Below) The fifth F-15B built was assigned to the 555th. It is painted Air Superiority Blue and carries the Green tail bands of the 'Triple Nickle'. (Arnold Swanberg via Jerry Geer)

(Below) A pair of F-15s of the 555th over Luke AFB in December of 1980. (USAF by T/Sgt Bob Williams)

began to appear. Externally identical to the single seat A and two seat B model, the newer C and D variants carry an additional 2,000 pounds of internal fuel, an additional UHF radio, improved ejection seat, improved landing gear, a strengthened airframe, and an advanced radar which permits target lock-on at ranges of up to fifty miles. These late model Eagles are also capable of carrying the McDonnell developed FAST (Fuel and Sensor Tactical) Packs. Fast Packs are conformal pallets which are fitted to the fuselage sides and can hold up to 4,875 lbs of fuel, reconnaissance or ECM sensors, and are designed to the same load factors as the basic airframe. In a move to cut maintenance man hours on the newer model F-15s, the external engine nozzle flaps (christened *turkey feathers* by the troops) were removed. Removal of the *turkey feathers* resulted in a ten percent savings in engine maintenance hours, and a dollar savings of $1,200 for each of the 17 per-engine flaps. The slight increase in drag was considered well worth it.

In 1982 and 1983 NASA tested a digital electronic engine control advanced fuel management system. The system was based on a 16-bit microcomputer with 8.5K of memory, which controlled a gas generator and afterburner control unit. Tests were completed in mid-1983, and the following enhancements to the F-15's performance were noted:

Level flight speed of Mach 1.15 in military power at altitudes of 30,000 to 40,000 feet.

Acceleration from Mach 0.8 to 2.0 is forty-one percent faster than with the standard F-100 engine.

Takeoff roll of 1,200 feet in 9 seconds at maximum power.

Time to climb to 10,000 feet of 41 seconds.

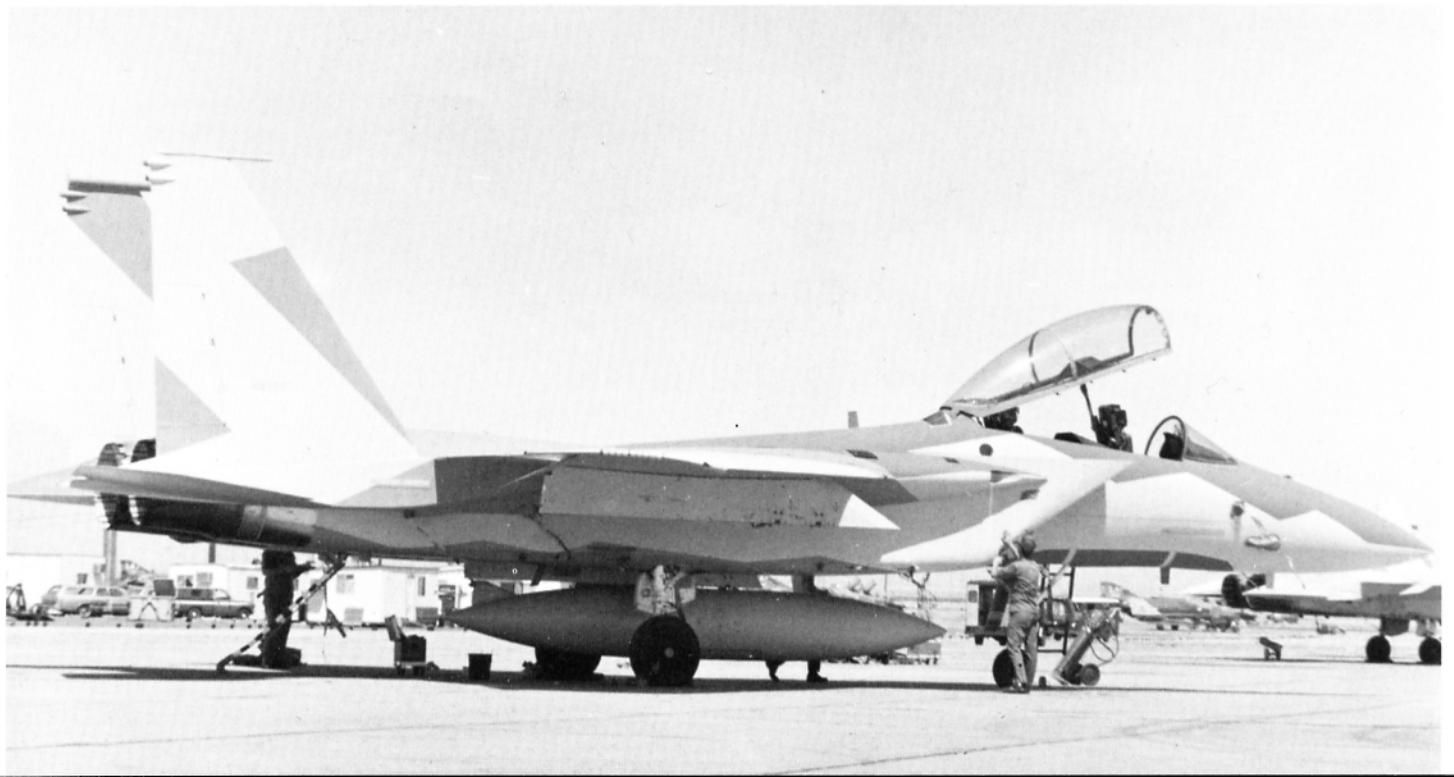
Unrestricted throttle operation.

Airstarts at 200 knots at 10,000 feet, which is 50 knots slower than the standard F-100.

In late 1983 the Air Force awarded a $274.4 million contract to McDonnell Douglas for modifications to the radar, central computer, and armament control systems on the F-15. This upgrade was a part of the on-going multistage improvement program (MSIP), and would result in greatly increased capabilities with current and future weapons systems, specifically the Hughes AIM-120 AMRAAM. These modifications included additional electronic counter-measures, multiple engagement/launch capability for the AMRAAM, increased detection range on the APG-63 radar, better detection capability in the tail-on aspect, improved raid assessment capabilities, a 300 percent increase in radar computer processing speed, a 500 percent increase in radar computer memory, with room for a further 1,000 percent increase in memory, and finally, a twenty-five percent increase in reliability. These improvements were scheduled to be added to 1985 production airplanes, and the mission control computer and armament control panel modifications were to be retrofitted to operational F-15s in 1985.

F-15s of the 58th TFW carry out a routine climb angle over the Arizona desert, December 1980. (USAF by TSgt Bob Williams)

The Air Force painted F-15B 74-139 in the Keith Ferris designed deceptive splinter camouflage scheme in order to assess its effectiveness. One of the most effective aspects of this scheme is the painting of a false canopy on the bottom of the airplane, making it difficult for an enemy pilot to tell if the F-15 is turning into or away from him. More than just a random collection of zigs and zags, the Ferris scheme is a carefully thought out attempt to not only hide the airplane, but to mask its identity once it is spotted. (Brian Rogers via Jerry Geer)



This F-15A of the 58th TFW, is one of thirty-six block 16 aircraft built. (Wally Van Winkle)

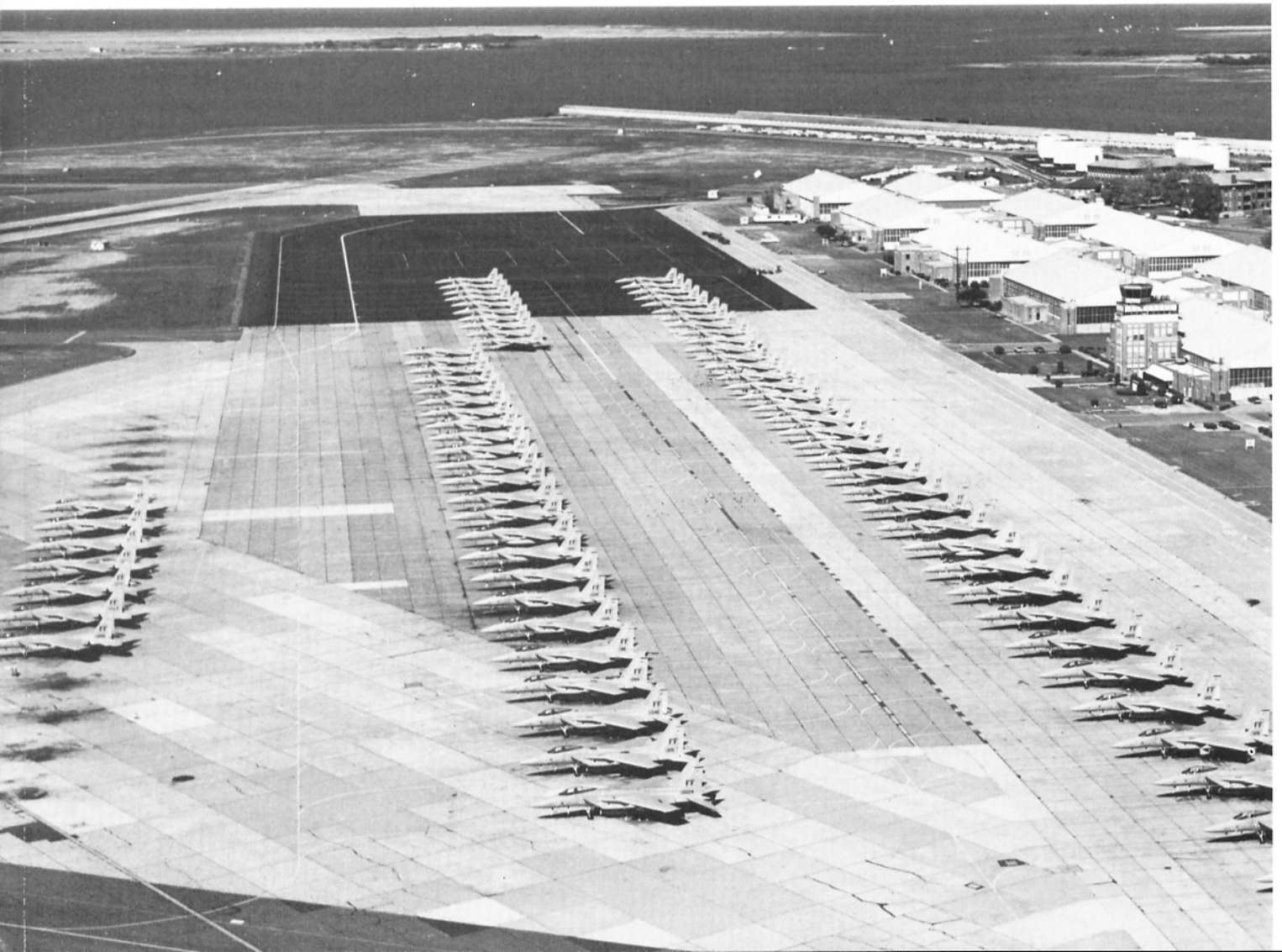
(Below) F-15A of the 58th TFW was detached from Luke AFB for service with the 57th Tactical Training Wing at Nellis AFB. It carries the 57th badge on the intake as well as the Yellow/Black checkered tail bands, while retaining the Luke tail code. (Wally Van Winkle)

F-15A-12-MC of the 461st TFTS, 58th TFTW at Luke AFB, Arizona with a false canopy painted on the under surface of the forward fuselage in May of 1977. (Charles B. Mayer)

(Above Left and Above) The 1st Tactical Fighter Wing, coded FF, was the first tactical fighter wing to become operational in the F-15. They received their first Eagles in January of 1976. (Shinichi Ohtaki)

(Left) A flight of 1st TFW Eagles on the line at Langley AFB. (Wally Van Winkle)

(Below) By 1977 the 1st TFW had fully assumed its role as the premier F-15 fighter wing, handling worldwide commitments to train new F-15 wings, and show the flag in foreign deployments. It was a rare day that the ramp at Langley AFB, Virginia contained this many Eagles at roost. (USAF by SMSgt Bob Kapperman)



EAGLE FLIGHT

"What else do you guys call the F-15? I mean, practically every airplane I have ever dealt with has a nickname, a name other than the 'official' name...you know, like Thud, or Hun, or The Electric Jet." I was talking with a group of high-time Eagle pilots from the 49th Tactical Fighter Wing, and it just seemed to me that an airplane as impressive as the F-15 Eagle must have an unofficial tag that spoke eloquently of the pilot's love for the best fighter in the world. I had heard of Eagle pilots being called *Ego Drivers*, but had yet to hear that magic name which would inevitably stick with the F-15 throughout it's career.

There was a lot of head-scratching, and looking around the room before someone ventured; "Eagle Jet?" Another chimed in with "Sleek and racy jet." It was obvious that the name I was looking for had not been added to the fighter jock's lexicon. There was a long and pregnant silence...then, one of them said, in almost reverential tones...*AWESOME*.

AWESOME and I had a date on 9 May 1984 at Holloman Air Force Base, New Mexico. I had been waiting a long time for the Air Force to approve my orientation flight in the F-15 Eagle, so when they said they could find the resources to accomplish the flight at Holloman, I made arrangements to get there...and getting there, believe me, was not half the fun! Holloman is near White Sands Missile Range, and is surrounded by desert. The nearest town is Alamogordo, and the folks at Holloman are fond of telling visitors that Alamogordo has the most beautiful beaches in the world. No water...just beautiful beaches. They may not have surf, but they do have an abundance of VFR weather, which is great for training fighter pilots in the art of air-to-air combat.

Mornings are really the best time of the day, and a severe clear morning when you are going to fly in the world's best fighter is an experience that is without equal. I met Major Chris Weber, Public Affairs Officer for the 833rd Air Division, at 0730. Forty five minutes later I was enjoying a typical 'lying and flying' session with Col Jerry Cox, Commanding Officer of the 49th TFW, Col Hale Burr Jr, DO of the 49th, and Lt Col Dave Rickert, Commanding Officer of the 8th TFS. All of them are combat veterans of the Vietnam War, and their experience allows them an appreciation of the capabilities of the Eagle that some of the younger fighter jocks just don't have. Naturally, they were very enthusiastic about the Eagle, their mission, and their ability to perform their mission. It wasn't always so, and just having the best airplane for the job does not guarantee you an effective fighting force. As recently as 1978 the Air Force was in serious trouble when it came to recruiting and retaining quality people. The Carter administration did not support a strong military capability, though his Defense Department pressured commanders into certifying their units 'C-1', or combat-ready. "But you can't bullshit the Captains," as a senior wing commander told me. "They knew that they were not ready to go to war, and were not likely to be ready with the kind of civilian leadership we had. Rather than take the chance that they would have to go to war and get their clocks cleaned...permanently...they were resigning." Naturally, this attitude filtered down to the enlisted ranks, and maintenance suffered accordingly. That all changed in 1981 with the inauguration of the Reagan Administration, and today the American military is just possibly one of the most effective fighting forces in peacetime history. Inevitably, these three senior fighter pilots compared today's mission, and the Eagle, to their missions in Vietnam. They all agreed that the USAF would have produced a lot more aces, even with the limited opportunities for kills that prevailed during most of the war, if they had been going to Hanoi in F-15s.

I can personally vouch for the fact that USAF air-to-air capability, as demonstrated by the 8th TFS, is breathtakingly effective. My personal demonstration of this capability began with a cockpit briefing in a two seated F-15B.

Our wingman for the upcoming flight, Captain John 'Houdini' Rudin, took me to the Eagle cockpit mockup which the wing uses for such briefings. I put on a harness, climbed in, and he pointed out the ejection firing handles for the Aces II seat, and the safety lever. The safety lever simply snaps down over the firing handle, preventing accidental initiation of the ejection sequence (a BIG improvement over the F-4 seat, which has to be disarmed by reaching back over your head to insert a safety pin in the top of the seat). There is a Command Selector Valve Handle on the rear cockpit panel, which allows the back-seater to select one of three options for ejection: 'Solo', in which the rear seat is not fired; 'Aft Initiate', in which the back-seater controls the ejection of both pilots (necessary if the pilot should become incapacitated...which would probably only happen during peacetime in the case of a bird strike.); 'Normal', in which the Aircraft Commander controls the ejection. Incidentally, the guy in the back always goes out first, to avoid being flame-broiled by the front seat rocket ejection motor.

The new fighters are famous for being easy to fly. They are designed to

F-15C of the 94th TFS, 1st TFW snaps into a multi-G break over the Virginia countryside in June of 1983. Condensation streamers can be seen trailing from its wingtips in the humid low level air as a result of the G force. (USAF)

allow fledgling fighter pilots to concentrate on their mission, without constantly worrying about flying the airplane. With this in mind, and considering all my experience, I asked Houdini if I should consider landing the airplane if my pilot became disabled. He thought about it for a couple of milleseconds, then said, "Naw, you'd better just jump out." What a blow to my ego! I mean, what private pilot doesn't dream of being put in the position of taking over the controls of the airliner and landing it safely? And to get the chance to land a fighter...well, that would be just that much better. But as he explained, the visibility isn't all that great forward, and the extreme nose high landing attitude of the Eagle would make it just that much tougher to pull off, even if I had had some experience. "Besides", he said, "the Aces II seat is so reliable, you have virtually nothing to worry about. Of fifty-four ejections, there have only been two fatalities, and those were not because of seat failure. One guy went into a lake and drowned, and the other guy got dragged by high winds."

Strapping into the F-15 is relatively simple. You are already wearing your parachute harness when you get into the airplane, so attaching yourself to the seat is a matter of snapping the survival kit buckles, parachute riser buckles, and lap belt into place. Then you only have to plug in your oxygen/com line and G-suit hoses, and you are ready for action. He had me go through the sequence a couple of times to make sure I understood it. I knew there would be a crew chief to help me with any problems, but he wanted to make sure I could get out on my own, just in case we had to exit on the ground in a hurry. Houdini warned me about the height of the F-15 cockpit. The cockpit rail is ten feet in the air, and if you simply step over the side, you are probably going to be seeing your neighborhood orthopedic surgeon. When he was sure I had it down cold, we headed for the briefing room to get the mission details.

Casino Flight was a four ship flight, Captain Rick Hendricks leading, with Captain Gary Kooney on his wing. I would be in the back seat of Casino Three, behind Captain Jim 'Tony' Mahoney. Houdini was flying our wing, in Casino Four. The mission would be divided into phases, and when we got to the air-to-air stuff, we would split into two flights of two. When that happened, we would become "Gimp Flight". One and two would still be Casino, but three and four would be Gimp One and Two. I wasn't too crazy about that name...I certainly didn't want anything to do with a 'gimpy' airplane at 600 knots and 35,000 feet! I consoled myself with the fact that these call signs are spit out of some computer, which only picks them for their ease of transmission and recognition over the air — not because of any perceived or anticipated events in the flights concerned.

Rick Hendricks conducted the briefing, and it was a model of the clipped jargon and hodge-podge of acronyms so necessary in the military. I have

tried to clarify some of the more arcane language in parenthesis, but if your'e not well versed in military aviation jargon to begin with, it may be somewhat difficult to follow.

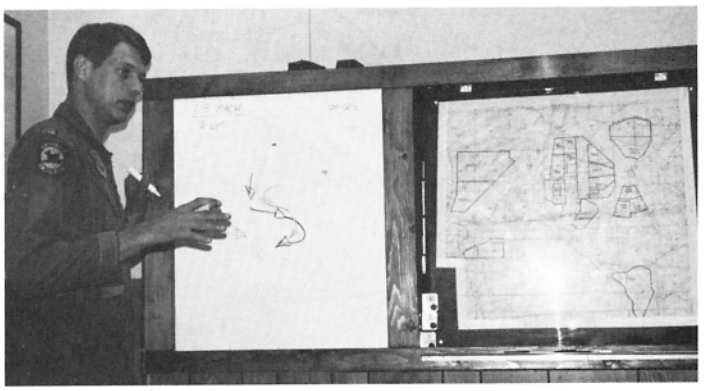
It went like this:

We'll be defending the south part of Valentine (Valentine Military Operating Area, a huge restricted area along the Rio Grande River, some 100 miles southeast of El Paso) simulating South Korea against a North Korean threat. Before we do that, we'll go down to AR-650 (the air refueling track) and do some air refueling, take on 4,000 pounds, go into the area, do our work, and come on home. The flow I want to use today is formation takeoff for everybody, fifteen seconds between us (1 and 2) and y'all (3 and 4). Join us up close, look everybody over...then kick you out to route. Once we hit skeen (a navigational fix) southbound, maybe even during the climb, I'll say fluid. Like to talk about the formation a little here...After we do the rendezvous with the tank, we'll tank 1-3, 2-4...pretty standard...then two v two ACBT (air combat maneuvering), return in the same formation that we flew out in. We'll do formation landings, with 3 and 4 in two mile trail behind 1 and 2. Alternate mission: If we get down to three airplanes, because an airplane breaks, or whatever, we can still do the same mission, as long as we have two flight leads...same scenario. Two ship: Through the refueling will stay the same. Once we get into the area, two ship will do an intercept profile and then move into BFM (basic fighter maneuvers) as a two ship after we do the three or four intercepts...two each...no lock, CC out, etcetera. Single ship, don't go to the tanker. Go to Roswell, do some instruments (approaches) and bring it on home.

Weather. That's really a non-player. I just talked to the weather girl, and she said its clear at the flight level where we'll be doing our refueling. All the alternates are clear, with at least seven miles on the viz. The wind is forecast to be 160 (degrees) at 6 (knots) on our return. O K, alternate mission: if we don't have a tanker before we get airborne, we'll just slip our takeoff, or we'll find new airspace. Either an Ops-Late takeoff, or we'll find new airspace. We'll re-brief at the duty desk on who's got what point and when. If there's no tanker after we get airborne...boom breaks, or the ninth takes part of it home with them, we'll just go on to Valentine, try to bootleg some airspace from who's ever in there...we've got blocked in on both sides, front and back, O K, so we'll try to take south of the center point, or north of the center point and work something that way, still doing the same scenario, two V two. ARCT (air refuel contact time) is 1115, which means we cannot slip that takeoff more than three or four minutes and still make our tanker time. So if you have a problem with the airplane, give maintenance a call, abort early, get a redball...whatever it takes to get a new airplane, so we can meet a 1025 taxi time. We are going to taxi with whoever we've got, marshall out there at the end of runway 22, and takeoff no more than 5 minutes late...we just can't afford more than that.

Joker 65 is the tanker bingo. ('Joker' is a predetermined fuel state, in this case 6500 lbs. 'Bingo' is minimum required fuel to return to base with a reserve.) If we haven't got gas by then, that two ship is coming home, and a bingo of 55 down in the area. Notams...El Paso is our best alternate, if we need to go any place but home, and there are none in effect at this time. FCF...maps, and we're all signed off. Personal equipment is standard. Preflight...weapons and the airplane, in accordance with the appropriate checklists. After start, we'll check you in, get a have quick check, and were not planning to use them but just to make sure they work so we can write them up if they don't. Clearance...could be lengthy. Make sure you copy it all down, acknowledge it on balls when I send you to Channel One. If you miss something, let me know and I'll read it back to you. Standard four ship line up on whatever runway we get. Signals (hand signals)...pass'em up. pass'em down.

After takeoff — departure restrictions: Be a left turn-out, lookin' for the 076 radial (from the TACAN) outbound all the way to 40 DME. The only restrictions are altitude restrictions, which are no problem in the F-15. The only problem we might have is to be above flight level 290 (29,000 feet) in this area, which is where the T-38s are working. If ATC holds us down too long, they might end up having to vector us around. Be heads-up if they tell me "direct pinon", or give me a heading, be flexible on the formation and just power your way in. Then we go on down to Wink, which is the SID (Standard Instrument Departure) exit point, on down to Fort Stockton to the ARIP, which is also the entry point. The box there is a left hand pattern for the tanker, and we'll talk about the rendezvous here in a second.

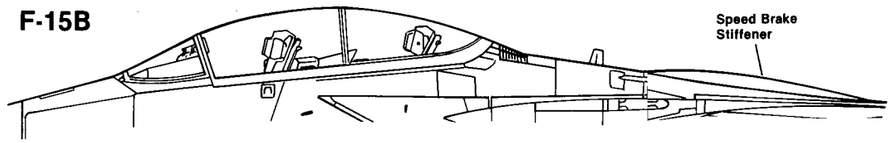


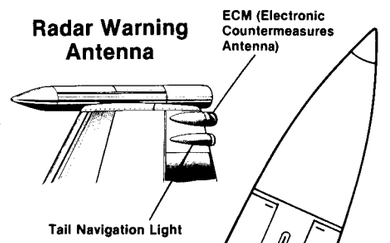
Captain Rick Hendricks makes a fine point on air combat maneuvering during the briefing for the author's orientation flight in the Eagle. (Author)

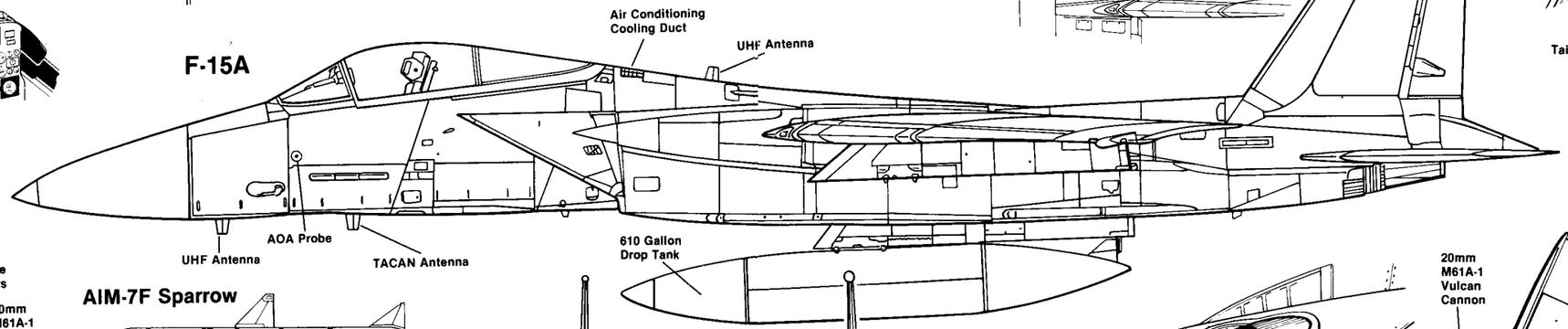
(Above) Gimp Two, Captain John 'Houdini' Rudin, pulls his gear up as we accelerate away from the runway at Holloman, and (Below) tucks it in close as we join up to become Casino Flight. (Author)

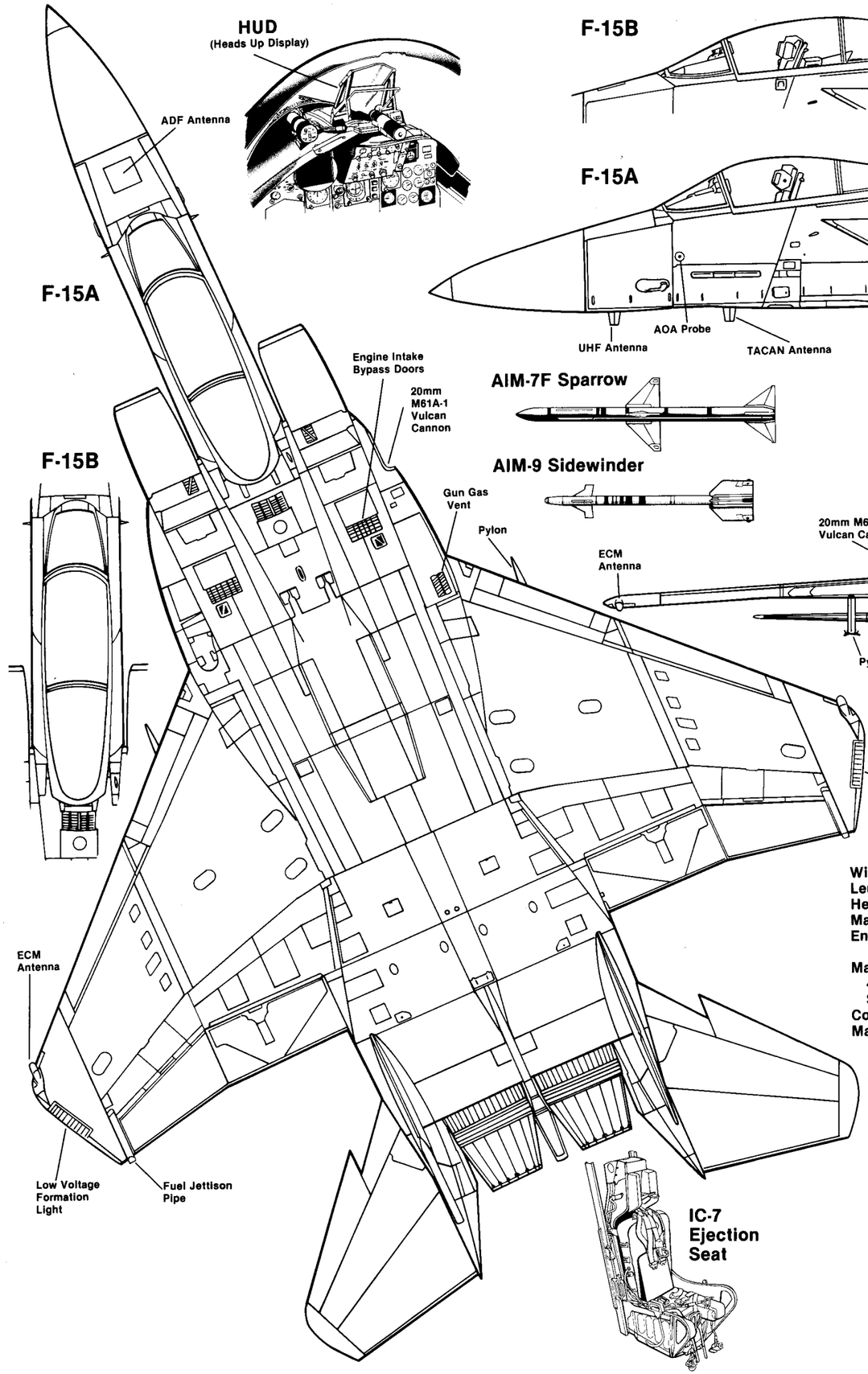
I'll skip the AAR and the ACBT and talk about comin' home from Valentine now. Let's join up in close four ship, and we'll plan on doin' that at the exit point, which is M1 on your INS (Inertial Navigation System). At the exit point try to be in the 27, 28, 29 (thousands of feet) arena, and plan on climbin' up to flight level 390 for the trip home. Route will be direct Salt Flat, direct Ziper. I'll break you up to the two mile trail somewhere on the Arc, prior to turning left for Lacky. Tell you to drag, call your ties, call your two miles...and we'll do all that in the main, so that we know that ATC knows what we're doing. I'll call "slowing to 250", call gear, and then call your individual final approach fix. If the winds or other conditions don't allow that, we'll just fly down initial, pitch out and land.

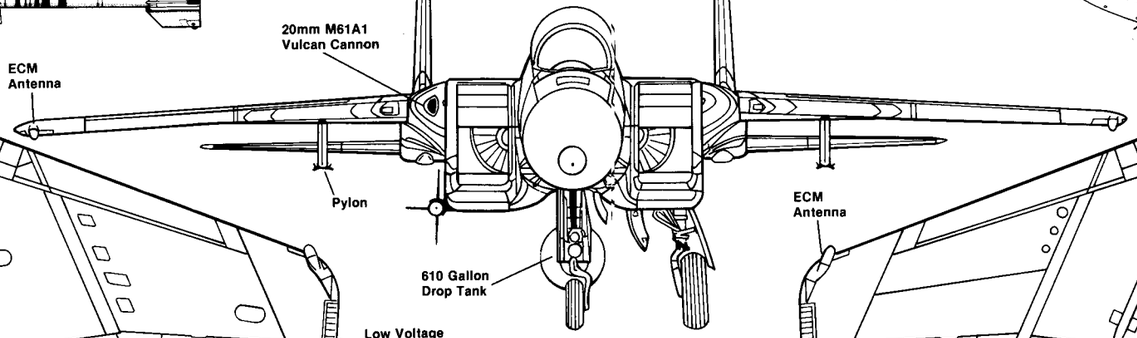
Aborts: Fifteen second separation, (between flights) so it's real important for 1 and 2 to tell the people behind us what we're doing, so they can make a decision on whether to go or stop. If you want to stop, Tony, the call will be "Gimp Flight, abort" then maintain your half of the runway as a two ship.

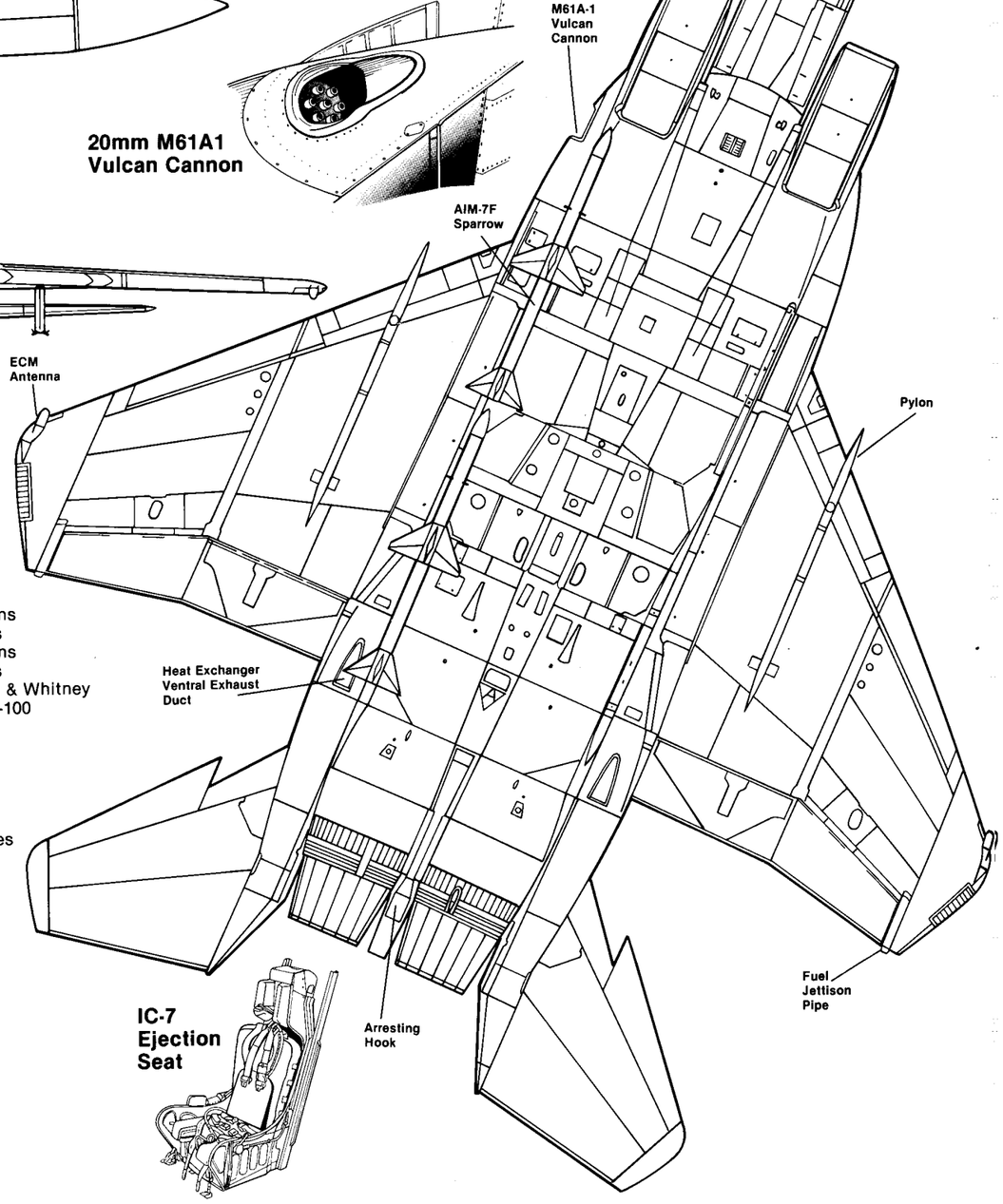












Arresting Hook

Specifications

F-15A/B

	F-15A	F-15B
Wingspan	42 ft 9.7 ins	42 ft 9.7 ins
Length	63 ft 9 ins	63 ft 9 ins
Height	18 ft 5.5 ins	18 ft 5.5 ins
Maximum Weight	56,000 lbs	56,000 lbs
Engines	Two Pratt & Whitney F-100 PW-100	Two Pratt & Whitney F-100 PW-100
Maximum Speed		
45,000 ft	Mach 2.5	Mach 2.5
Sea Level	Mach 1.2	Mach 1.2
Combat Ceiling	63,000 ft	63,000 ft
Maximum Range		
Endurance	4.6 hours	4.6 hours
Ferry Range	2,500 miles	2,500 miles
Crew	One	Two

1/72 Scale

By Kevin Wornkey

The three F-15As of the 8th TFS, 49th TFW, which made up three fourths of Casino Flight. They are all block 20 aircraft, the last A models manufactured. (Author)

Low altitude ejection: You guys talk about crew coordination, and the ways of getting out of the airplane. The big thing is no sink rate, positive rate of climb, bank angle, etcetera.

Nordo to and from the area: To the tank, if you're Nordo (no radio), join it up, give us the Helen Keller act as far as what your problems are. Thumbs up if that's Nordo only, and thumbs down, plus the appropriate HEFOE (hand signals that indicate Hydraulic, Electrical, Fuel, Oxygen or Engine problems). Nordo only, plan on flying with us to the ARIP, and then RTB with your two ship. We have Nordo points in the area if that happens and you're single ship. Rescap, let's use 2828 on the radio instead of guard so it's not all garbaged up.

At this point in the briefing, the emergency of the day was discussed. Every flight lead assigns a review of an emergency procedure prior to briefing, and the procedure is reviewed by one of the other flight members. Today it was air start of the engine(s), and Gary Kooney held forth on the steps involved in an air start of the F-100 engine.When the airstart procedures had been thoroughly thrashed out, Rick continued the briefing.

Spatial disorientation should not be a problem today. Brown is always down, and blue should be everywhere above the horizon. If you get disoriented, One: call it out on the radio so your element wing, or lead can give you some directive commentary, recheck your instruments on the inside, and then once you get within the window for the autopilot turn that on and get your gyros caged back. Terrain avoidance: Down in Valentine, it looks like the highest terrain is in the west part of the area, near the Rio Grande, and we'll try to work the center area and weather shouldn't be a problem for that today. Fifteen thousand feet is the ATC floor of that area, so the terrain shouldn't be any problem at all. There are no airspace restrictions that we know of at this time, though they may restrict us from that northeast corner. That only happens when the SR-71s are refueling. Fuel awareness: Don't cheat on that 5500 bingo, or 6500 joker. It's going to take that much to get through ATC and get back here.

Supersonic flight today is not approved, down in Valentine or on the way out or back. We have a common frequency and two auxiliary frequencies. Use the main freq for pushin' your shots, knockin' it off, callin' the fights on. Mutual support is a mandatory requirement, and just smart flyin' for the F-15. The MIG simulators today can be single ship, two ship, split up two ship, with timed attacks...whatever you think is fair today for simulating the threat that we are trying to simulate. We have an altitude box established. Rear quarter attacks always against the trailer. If it gets down to two ship BFM, and you lose sight of the other airplane, call it on the radio, with your altitude, then the other ship avoid that altitude until you get back together. We're using a 500 foot bubble, 1,000 foot slant range for any shots except for head-on missile attack, where you want 9,000 foot min range before you come off. With a 4 G pull, that will take you real close to that 1,000 foot bubble. Head-on, clear to the right, if your nose is up, keep goin' up, energy permitting. Front quarter gun attacks...90 is fine, 130 is fine, anything more than that, its time to come off. One, you're going to lose sight of the guy you are attacking, and Two, you really cannot judge that pure pursuit in that 1,000 foot bubble. Use of the sun: If you are a defender, and you drag an attacker through the sun, he is probably going to lose you, so keep track of him. If you lose sight of him, at least be predictable, and listen on the radio for the attacker losing visual contact. At that point you should call "Knock it off", and start over.

We will knock it off if: we get close to the area boundary, anybody else comes into the area, min altitude or clouds become a factor, situation awareness is lost, or anybody rocks their wings, desired objective is acheived, stalemate occurs, dangerous situation is developing, we get down to bingo fuel, or anybody calls "knock it off".

The formation we've been workin' on for the last couple of months...the fluid four...still seems to be givin' some guys trouble. The altitude we've requested today...37 with the block to 41...4,000 foot, so we can get a good stack, we can see some aspect in there to judge our in and out. I won't be using air-to-air TACAN...I'll be using that for navigation...OK, so don't plan on me having that. You're just going to have to be eyeballing it. What we want is 9,000 to 12,000 feet between elements, and 4 to 5,000 between wingmen. When we make the turn at Fort Stockton, I'll call "Fluid Right", and it's going to be about a 60 degree right hand turn, so plan on that. Wingmen, before we get there, go ahead and start collapsin' back to more of a fighting wing. Move it in...2,000 to 3,000 foot range...to about maybe 60 degrees back and anticipate the crossin' over or crossin' under, depending on where you are. I'm not going to touch the power, it's just going to be 45 degrees of bank...you'll have some power to play with, but not much up there.

Air to air refueling...formation...we'll be in route after we make the turn at Fort Stockton. After the rendezvous with the tanker, when he clears me into the observation position, I'll do my checks. Don't open your refueling door until the tanker clears you into the observation position. And the reason for that is, if you get into the habit, and do that at nighttime, and I'm on your left wing, your'e going to blind me with that light (the refueling light, which comes on when the door to the refueling receptacle is opened).

Mandatory calls: We'll be callin' when we leave the initial point there, be coordinating back and forth with the tanker to make sure we have the proper altimeter setting, what altitude we're at, what offload we want, got the aerial TACAN set, any time we get or lose radar contact, any time we get Tallyho or lose Tallyho we need to tell'em. I need to tell him to start his turn, I need to tell him to push it up about half way through the turn when I get my parameters met. I'll call 'Casino, weapons safe.' and I want you to acknowledge; "two, three, four"...and he'll want to hear that too. "Checklist complete, Stabilized and ready...Casino One, cleared contact...Roger...Casino One disengage...Boom's clear."

There follows a discussion about the relative position of the tanker prior to rendezvous. The consensus is that at twenty-one miles he should be twenty-six degrees angle off the nose on a reciprocal heading, and that they (the F-15s) will tell him when to start his turn into us.

Rendezvous with the tanker: Let's see, it's a KC-135, right? Observation position...the thing you don't want to do is distract the guy that's on the boom. The common tendency is for everybody to lag back, but you should fly abeam the aft emergency door, about halfway up the tail. Line it up so that you can see the opposite wingtip of the tanker over the top of the fuselage. You ought to be able to see the guy on the other side of the formation in front of the tanker's tail. Now, if he makes a turn into you...yeah, that'll get your attention...but with this canopy on the F-15, it's very easy to just roll with him, pull and turn, then start your nose down to match him.

Refueling technique: This airplane, compared to others is more difficult, I think, because of the turbofan engines. When you add power in other airplanes, you're movin'. In this one, yeah, you're movin', but when the fans finally catch up to the engine, you're moving more than you want. So it's very easy to get into an energy PIO (Pilot Induced Oscillation). First problem you're going to have is when you get up to that big knuckle where the boom comes out...the airflow around that is so disruptive that you have to add power to get through it. So you're going to have to add some, then take it back out...the fans will catch up, and it should be just about perfect. If you leave the power there until you move through the turbulence, zoom, you're going to move through and keep on goin' and end up underneath the darn tanker. So when you're out there, start level with the boom, offset just a little bit, then fly right up the right wing root of the tanker. But watch that power...add some, then take it out. You want to adjust your seat so that the canopy bow and mirrors don't interfere with your sight picture on the tanker. If it is a problem, disconnect, back out, adjust your seat, then go back in and get your gas. You can adjust your mirrors to watch the knuckles (on the refueling boom) if you want to do that. If I do that, it tends to disorient me if I get distracted, since what you see in the mirror is really the opposite of what is happening back there. Be cautious in doing that...I would look at the tanker and the director lights (a row of lights on the fuselage bottom of the tanker which aid the refueling pilot in lining up properly) until I had a lot more time on the boom, and then start cross-checking the mirrors. Takin' on 4,000 pounds should take about a minute and a half. When you've got your offload, call "disconnect now", but don't move anything until you see the light go out and the boom go by your head...I don't want to be bringing part of the tanker home with us.

Problems: Weather should be no factor today, but IF the tanker should happen to find the only cirrus cloud in the sky, which they tend to do, then we'll handle it like this: if your on the wing of the tanker, it's the standard procedure...fifteen degrees (of bank away from the tanker) for fifteen seconds, with addition that you reduce the airspeed ten knots. If you're on the wing of a receiver, it's 30 degrees for 30 seconds as well as the speed reduction. If you're in the contact-pre-contact position, reduce airspeed ten knots, descend 500 feet, wait 30 seconds, then resume airspeed until you can acquire the tanker visually. Of course it goes without saying that you get on the gauges right away. Also, you have to request permission of the tanker to turn the radar back on to reacquire contact and rejoin the flight.

If you get contact, and the boom doesn't lock, or is not gettin' fuel flow...disconnect and try again. If it still doesn't work, you have to go override...you have to tell him you're going override so that he knows that he cannot unlatch the boom...it's all up to us now...OK, and you'll have to pressure refuel. If that doesn't work, you can go to strictly manual...pushing...and you'll be able to feel him pushing you with the boom, and you'll have to push him back with the airplane. That's pretty hard to do...not the ideal solution. If it

Casino Lead gets his gas from a KC-135 of the Texas ANG. (Author)

Casino Two demonstrates the proper wing position to fly on the tanker, as number One has disengaged. The normal order for refueling is One, Three, Two, Four. This means that the wingmen will be the last to get his gas, and should therefore be in better shape to maintain position on flight and element leads. Maintaining position always takes more gas! (Author)

One and three fly the wing while we are plugged into the tanker. (Author)

Echelon left at Flight Level 400. (Author)

comes to that today, we may just knock it off, and let the next man in. We will not blow any doors open, just to get them open.

Air Defense: There are a few things I want to talk about on this mission. Last night, thinking about this morning's mission, I made up a little matrix to cover the various scenarios. The F-15 was built for the radar, so we have to figure out how to use that radar best. I've got three different scenarios here; BVR (Beyond Visual Range), VID (Visual Identification), or VID and stay with 'em ala the shadow...off of alert here at Holloman. "Hotel Mike zero one scramble two (the call alert crews would get to scramble)." For instance, they've got a hijacker, and they want us to follow 'em around, which we've done before, being handed off from the Fresno Guard...or chasing down a lost civilian, or an airliner. So there's those three types, two that you can shoot on, and one that you can't.

There are three altitude bands that we can do that. Very high, which to me is anything above thirty (thousand). Medium altitude, which covers ten to thirty, and then low, anything below ten. And down there, there's a lot of consideration on nose position, look-down for the missile, formation, etcetera. Sitting alert, our primary job is not to shoot anybody. It is VID or escort. If we have to VID, I'm thinking we're going to do this: In a wartime scenario, we could get a high fast flyer...here today we've got the block 15 to 51 (thousand), and we could definitely get one up that high in a North Korean scenario. VID a high flyer...how we goin' to do that with this radar, and with this formation? That's a tough one...I've never seen anybody do a stern conversion on a Mach two target at 70,000 feet. So I think it's going to be a shooter-eye kind of attack formation, with plenty of Mach. In that, we've got one person committed high altitude...hopefully, we've got the 100 mile setup...heat it up, clean it up, speed it up, climb it up...all those rules apply, but we need to have some kind of offset for the leader or wingman, depending on who's got the good radar, or the good weapons system. So you pass the target, head-on 180 out...as high, close as you can, and call either friendly or hostile, and the other guy is looking for the head aspect to shoot. That's the only way I can see to do that mission.

BVR: I think we're lookin' at our standard line-abreast formation...two to three miles, and you may even want to split wider than that so we get some aspect. Lookin' at the standard formation, standard mach against the high fast, flyer, and we just shoot...shoot...shoot...shoot and recover. When I hear "clear to fire", or "GCI clears us to fire", I don't think that: One, we'd ever see that, or Two, I think it would darn near be impossible. There's just no way you shadow anybody at 70,000 feet, unless they give you a good cut off and plenty of turn radius. And with a tanked airplane and four missiles, I don't think there's any way we are going to keep up with a target that has the ability to outrun us.

Formation on a VID pass: Where does Two fly? I'll tell you a couple of places where Two BETTER NOT fly, and that is in the same plane of motion, same altitude, and up to two miles dead astern. What we want is some plus altitude or minus altitude between One and Two, depending on weather, terrain, or threat. And where do you want him to wind up? Personally, I would like you in pretty good heart of the envelope AIM-9 parameters. If you've got an AIM-9 Lima, that's even better, because you know what it's locked onto. (The 'Lima' version of the time-tested Sidewinder air-to-air missile is the latest and best so far produced.) That's the end parameter that I want you to be in if I have to go in and VID somebody. Low altitude VID...I think you can guarantee a stern conversion, shooter-cover.

Camouflage schemes are real effective. I think we learned that in Red Flag, Team Spirit, and around the world. So it will drive you in closer, your weapons systems parameters will drive you in closer...all the lethal envelopes shrink. So this intercept is probably going to be a stern conversion because by the time you get there, if you can get an AIM-7 off before minimum range, you're going to have to wait, time it out, and make some kind of corner as he continues on his flightpath...so your'e guaranteed some kind of a stern conversion. BVR...this is one where the threat will dictate. Always attack the trailer. The threat will dictate whether you just shoot one Lima in his face, or whether you ID the first guy as hostile, then go for the trailer and the first guy is just lucky, and hopefully, the air defense artillery will get him. You certainly don't want to go for the first guy and go belly up to the trailer! Alright, you guys (3 and 4) are cleared off to do some talkin', and we'll see you on the ramp.

That was the briefing for Casino flight. We (Tony, Houdini, and I) retired to another briefing room to talk about our tactics during the air-to-air engagement. This reminded me of the neighborhood pick-up touch football game, where everyone gets in the huddle and the Quarterback says, 'OK, you go left, you go right, and you go deep, everyone cross, zigzag, and I'll throw the ball as far as I can!' Well, it wasn't quite that unstructured, but it was obvious that both element leaders wanted to make the other guys job as tough as possible. We would each get a chance to simulate the Migs, and then be F-15s on the next engagement. While we were Migs, we were limited to their tactics, but we could use the F-15s radar and performance. (The thinking is that if you can beat an F-15 which is using Russian tactics, any Mig you come up against is going to be 'dead meat'.) Tony and Houdini decided that whoever was engaged by the other two, would stay engaged in a one V two and try to hold them off until the wingman could come in and shoot them off his tail. When the split came, Tony would call either horizontal or vertical separation, and in which direction he wanted Houdini to go. When we were F-15s, we would be in the block 21,000 to 24,000, and Tony cautioned Houdini to get a good altitude stack as well as the two to three mile horizontal separation. He would have responsibility for radar search from twenty-five and up, and we would take it low. There followed a discussion of radar search parameters and various ranges. Since we were playing VID today, Tony called for a modified 'hook eye' attack on the Migs, which (naturally) called for a stern conversion, in which it was hoped that Tony would pass the leader head-on, VID him as an enemy, call 'Bandit, Bandit!' and, as he said, "We'll play guilt by association...you lock up the trailer and call 'Fox One, Fox Two', when in range." (Fox One signifies a radar-guided AIM-7 Sparrow shot, while Fox Two indicates a Sidewinder shot.) The Sparrow is the F-15's long range missile, while the Sidewinder is the close-in missile. Closer still, you can use the 20MM cannon, calling 'Fox Three'. (Fox Four is the not-so-funny tongue-in-cheek indicator for mid-air collision.)

Zipping yourself into a G-suit probably becomes as natural as putting on your socks when you do it everyday. Me, I still have to have someone tell me where to start, and which way is front. (Actually, the recommended procedure is to put it on backwards, so you can get the waist zipper and hooks in place while you are looking at them, then slide it around to the proper position before zipping up the legs.) Snapping and zipping a G-suit on over your 'bag' (flight suit) really makes you feel more the part, but by the time you shrug into the harness and snap it up, you realize fully that this whole outfit is made for sitting...definitely not for walking, which you do with a modified

bow-legged straddle.

I had my own helmet, an older HGU-26/P double visor model, which I had had custom fitted to my head by Protection, Inc. in California. (I wear it when flying my T-34.) I only needed an oxygen mask fitted, which was done quickly by the 8th's Personal Equipment Specialists. My helmet is painted the same color as the T-34 — bright yellow. I have added a black visor cover, with dayglo lightning bolts. Though they were too polite to comment, the other members of the flight looked as though something that gaudy just didn't belong in the Compass Ghost Gray F-15. Their own helmets are the later HGU-48/P super light custom fitted models, all in uniform Gray. (This is one area in which the individuality of the fighter pilot has given way to tactical uniformity — at least in this wing.) The advantages of the newer lighter weight helmets (they are molded of Kevlar) would be painfully evident in a high-G turning fight but, I wondered how much protection they would afford in a crash environment.

Captain Johnny Johnson, of the 479th Tactical Training Wing, also at Holloman, told me that most studies had shown that helmets are usually lost in ejections anyway, and in some cases, have caused broken necks because the chin strap snapped a neck before snapping itself. USAF has also discovered that a real hard hat transfers shock forces to the head, while a lighter custom-fitted helmet absorbs shocks. "Anyway," he said, "all we really need a helmet for is to hang our mask on." The HGU-48/P also is smaller than previously used 26/P and 34/P models, and weighs about half as much. Since it is so light, there is less inertia associated with any real quick moves, like a high speed ejection, and there is more chance it will stay put on your head.

Getting strapped in was relatively simple...at least, I managed to get everything in the right place by myself. Once strapped in, I looked around for a spot to stow my cameras. Two seat Eagles are called 'Tubs' by the pilots. It is not a name affectionately applied, but if interior room is the criterion, it is an accurate name. There was loads of room on both consoles to stow my helmet bag and extra camera. When it came time for McDonnell Douglas to jam a lot of extra navigation and weapons delivery gear into the F-15 in order to come up with the F-15E Strike Eagle, they did not have to look too hard to find the room.

The derogatory feelings of the pilots towards the two seater have nothing to do with it's performance, since the B and D models have performance and weapons capabilities identical to the single seat A and C models. Fighter pilots, by popular definition, are single combat warriors. Fighters, no matter how many engines they have, no matter how sophisticated the avionics or weapons, no matter how big and heavy they are...are required by fighter pilots to meet the all-important specification of having ONE seat. If they object to the seat being back there, imagine how they feel when the Air Force sticks a Navigator in that seat — and worse, still — when they give the Navigator credit for kills that the pilot has made! Incidentally, the guys in the back seat are not currently called Navigators. Current vogue is 'Weapons System Operator' in the Air Force, or 'WSO'...which has become 'Whizzo' in popular usage. The pilot's ambivalent feelings about Whizzos were verbalized by one of them when he asked me the question; "You know what's wrong with flying with a Whizzo who doesn't wear glasses?" No, what? "Because then you don't know WHAT'S wrong with the SOB!" Since there is no mission for the guy in the back seat of the F-15B/D, these kinds of jokes are popular in Eagle squadrons. They would be less so in an F-4 squadron...or in the Navy, which tries hard to keep the image of that back seater (called a Naval Flight Officer, or NFO) polished, steadfastly insisting upon the value of an extra set of eyes and expertise in the avionics department.

During the 1960s there was a popular anti-establishment saying which cautioned youth of the day 'not to trust anybody over the age of 30'. In that age of polarity, the feeling was probably reciprocated more often than not. As Tony climbed the ladder to the front cockpit, it occurred to me that he was probably not 30, and yet was an experienced fighter pilot, who was a flight leader. There was no question about trusting him with the F-15. He had over 1,600 hours in the Eagle, with tours in Europe (Bitburg), at Langley, and now Holloman. He was a graduate of the Fighter Weapons School at Nellis, and had never had an operational assignment other than the F-15 in his Air Force career. His experience and credentials are a testament to how USAF doctrine has changed. This is the age of specialization. No more the airplane that can do everything, and no more the pilot who may move from B-52s to OV-10s. At least...not when it comes to the air-to-air mission. Lt Col Dave Rickert had told me that he considered it vital that his pilots practice their mission daily. "Dropping bombs is a science, and once you understand the physics involved, you can do a good job whenever called upon to do so. Air-to-air is more of an art, and a lay-off of a few days will affect your sharpness."

Once Tony had strapped himself in, he went throughout the pre-start checklist, making sure that all handles, switches, knobs, and the throttles were in the proper position. Starting the engines in the Eagle is further testament to the long strides the designers have made. Auxiliary power is not needed. The F-15 has a self-contained engine start system. The first step in this system is the Jet Fuel Starter (JFS), a small turbine engine that runs on jet fuel and is used to spool the F-100 turbofans up to start speed. The JFS is started by discharging one of two hydraulic accumulator bottles, which spin it up to speed, where it's own generator provides ignition.

When the green light on the panel announced that the JFS was up to speed, Tony raised the finger lift on the front of the right throttle, engaging the JFS to the right engine. It was immediately apparent that something was happening, since the airframe began to tremble as the right engine came to life. I heard the ignition thump, then seconds later the right intake ramp banged down. Tony was monitoring the Fan Turbine Inlet Temperature and RPM gauges throughout the start. With the right engine running and stabilized, he went through the same procedure with the left engine. As the left engine spooled up with fifty percent, the JFS dropped off line. With the left engine running, he turned on the Built In Test (BIT) system, one of the systems that makes the new fighters magic. The F-15, through the BIT system, checks and analyzes its own systems. If it detects a fault, chances are that the fault can be corrected by replacement of one of several LRUs (Line Replaceable Units or, as they are more popularly known, Black Boxes) in the complex control system. Chances are also that the LRU will be replaced on the spot, with short mission delays.

With the BIT checks complete, Tony concentrated on aligning the INS. Coordinates for our parking spot on the ramp were punched in,followed by those of the ARIP entry and exit points, the north and south rendezvous points in Valentine MOA, the FEBA (Forward Edge of Battle Area, or frontline. In this case, an imaginary line drawn through the middle of Valentine to designate the North Korean lines.) and the exit point from Valentine. It takes about ten minutes for a full alignment of the INS, which will give you accuracy to within a few meters. Less accurate alignments can be obtained within four minutes. With the INS on line, Tony closed the canopy and turned on the enviromental system. One more plus for the F-15....air conditioning in the desert!

Casino One was in the parking spot opposite us, and as he taxied out and turned toward the taxiway, Tony completed his checks of the flight controls, flaps, and speed brake. The crew chief disconnected his headset from the airplane and signalled that the chocks were out and we were ready to taxi. He exchanged salutes with Tony, and with a nudge of the throttles, we rolled out of the parking slot. The fan engines create a lot of residual thrust, so once under way, the trick is to keep the airplane from running away. The ride seemed very comfortable, without the stiffness that announced every seam in the taxiway so common in other fighters. The entire flight checked in on frequency, stopped at the last chance pit, where ground crewmen removed safety pins and AIM-9 seeker head covers, checked for hydraulic or fuel leaks, and finally waved us out.

We were cleared onto runway 22, and lined up in a tight diamond formation. We were on the left wing, with Houdini in the slot behind Hendricks, and Kooney on right wing. Casino One and Two rolled away, accelerating rapidly. Fifteen seconds later, Tony raised his right index finger and, looking at Houdini, rotated it to signal engine runup. As both engines stabilized at eighty percent, he put his head against the headrest and with an exaggerated nod, released the brakes and advanced the throttles to military power. As a pilot, I wanted to watch the instruments, but all of my other instincts were telling me to take pictures as we roared down the runway. I thought I could probably do both, but things were happening too quickly for me to make much sense of the gauges, so I just reveled in the sense of power and speed as we rotated with 130 knots of airspeed in less than 3,000 feet of runway. Tony's head nodded forward, then back sharply as he signalled 'gear up'. The F-15 accelerates so quickly that the gear has to be raised as soon as you are off the ground in order to avoid exceeding the gear transition speed, a limit that applies to the gear doors more than the gear itself. With the gear in the well, we continued to accelerate, climbing and turning left to intercept Casino One and Two.

They were at eleven o'clock high, and we closed the distance rapidly, pulling in tight on Casino One's right wing. With Houdini on our right wing, we were in a tight finger four, strong right. The VSI was still pegged at 6,000 fpm, as the desert continued to fall away. After a few minutes in tight, Hendricks kicked rudder left and right to signal a spread to route formation. We slid out a few hundred feet, as the climb to 31,000 feet continued. Our first navigational fix was Pinon VOR, and it came and went unnoticed from the back seat.

We leveled off and settled into cruise. Tony asked what kind of pictures I wanted to take. "All kinds", I said. Casino One acknowledged our request for a photo formation, and One, Two, and Four pulled into a V formation, while we slid from side to side, crossed in front of, and rolled over the top of their formation. Four dropped back and across to form an echelon left as we repeated our photo maneuvers. We were high enough to pull contrails, and watching the three Eagles bore through the deep blue pulling cons is an experience denied to all but a very few. (I didn't realize it at the time, but Hendricks was even more entertained by our maneuvers as we, in his words "made spaghetti in the sky" with our con.) I stowed my cameras as we spread

Gimp Two is silhouetted against White Sands as we make our approach to Holloman. Because of the high residual thrust of the F-100 turbofan engines, the final approach is flown with speed brake out. (Author)

into the fluid formation that has become the derigueur of air-to-air combat. This formation makes air combat without a good radar, or a real sharp GCI, a very risky business. The wingman is so far from his leader that even when you spot one, you are not likely to quickly spot the other without real good eyes and having some idea of where to look. Houdini was a mile to our left, and 3-4,000 feet below us as we continued south towards Fort Stockton VOR. It was positively serene...and then...suddenly, a red light on the communications panel lit up. Red lights on any instrument panel rarely signify good news, and in a jet fighter they are almost always bad news. And, just in case I wasn't paying attention to the panel, the red light announced itself with a very distinctive aural tone. The little red, flashing square proclaimed 'SAM'. Who would be shooting a SAM at us over Northern Texas? Had The Great State seceded and declared itself a People's Republic? Before I could consider that question further, Tony reassured me that it was probably just a missile battery at Fort Bliss, testing it's radar.

As we crossed Fort Stockton, lead started his hard right turn. Tony rolled into his turn, then rolled level to check Houdini to make sure that he had picked up the turn and was turning with us. He was and Tony quickly banked and yanked, inflating our G-suits for the first time in the flight. It was a relatively short run to the air refueling track, and Tony called my attention to the radar, pointing out the tanker, some 40 miles distant at our eleven o'clock. The tanker was in his block between FL 260 and 280 and we were descending as we closed the gap. The radar set up for intercepting the tanker at just the right moment became paramount, and there was a lot of discussion on the radio comparing radar returns. Casino One called the tanker at eleven o'clock and seven miles, just as the KC-135 started into his turn, going to our twelve o'clock. The set up turned out perfectly, as the tanker, call sign 'Crumb 41', rolled out right in front of us. Hendricks only had to nudge it up slightly to move into the observation position.

Hendricks moved in on the tanker and was plugged in and transferring fuel within a minute, and within another two minutes had unplugged and backed out. There was no evidence of the troublesome burble of air behind the boom. It was now our turn, and Tony slid over into the pre-contact observation position. The boom operator cleared us in, and Tony flew smoothly forward under the tail of the KC-135. I nervously watched the big boom slide past the canopy, hover over the refueling receptacle, then dive home with a distinct "klunk". I glanced down at the fuel totalizer on the right side of the panel, saw the needle quiver, then begin to rotate clockwise as the JP-4 flowed through the boom and into our tanks. We got our 4,000 pounds, called "disconnect" to the boomer, and as soon as the boom was retracted and raised, we slid out and back over to the tanker's right wing. Kooney moved in next, made an uneventful contact and got his gas. Houdini was next, and he had the misfortune to be cleared into contact in the middle of the tanker's turn. He did catch the burble, and missed the first attempt to get plugged in and get his gas. Tony commented on the ICS, "Bad Luck". It was too, since the boomer was now going to make it be perfect before he plugged Houdini in and gave him his gas. Houdini made it perfect on this third attempt, and got his gas.

We were now Gimp Flight, as Casino One and Two broke off and headed for the north side of Valentine to set up for the first intercept. I put both cameras away and concentrated on the radar, as Tony gave me a running commentary. We picked our adversaries up at 20 miles on the radar. Houdini was off to our right, about a mile away, but at our altitude. It looked as though the 'Migs' were heading straight towards us, in line astern formation. This was a common enemy formation, often seen in Southeast Asia. It was designed to try to entice you to turn on the leader, setting up number two with a perfect 6 o'clock Atoll shot. We would watch for that.

At seven miles, our radar went south, showing us multiple targets, then nothing but garbage. We were blind, with two Migs coming right down our throat. Tony looked up, trying to spot them — no joy. Suddenly, we heard Houdini call, 'Fox One, Fox One'...then a pause of a few seconds while he timed the missiles out, then called, "Fox One kill on the guy off to the east." Within a few more seconds we heard him call, "BREAK LEFT GIMP ONE, YOU GOT ONE AT YOUR EIGHT!!" Tony slammed the stick hard left and pulled. The suit inflated around my stomach and legs, and I grunted against the G force, straining to avoid a gray-out. (Even though I do aerobatics, regularly pulling up to 4 Gs without benefit of a suit, I have the maddening tendency to see stars under prolonged G loads — even relatively light G loads of 3 to 4.) I saw Tony looking out the top of the canopy about the time I heard Kooney call, "Atoll kill on one!". Damn! That was us, and he just smoked us! We had not seen him until Houdini called the break, and by that time it was too late. Tony was pulling hard to break his lock, and looking at him out of the top of the canopy the whole time. I was being given a demonstration of the advantages of the lightweight helmet, as I could not lift my head against the Gs without grabbing the bottom of my mask and pushing (no wonder fighter pilots do exercises to strengthen their necks!).

Houdini turned out to be the only survivor of the fight, as he pulled into range on Kooney, and called "Guns tracking...guns kill on the other one." Then, "knock it off". I was astonished at how fast things had happened. One minute we were droning along with the enemy on our radar, then within a minute of losing the radar, we were blasted out of the sky by the enemy. The Migs had split, one going east the other going west. Under those conditions, you are supposed to pick one, and both go after him. Unfortunately, we had not seen either of them, and when Houdini took off after the first, we were easy pickings for the second, who pulled right around behind us before we could make a move to follow our wingman. Events had unfolded unbelievably quickly, and we weren't even supersonic!

Casino flight got together and headed north for their second set up. This time we would be the Migs, and we headed south for our set up. It was a perfect chance to do some additional photography, and Tony suggested we try for a shot of Houdini going straight up. As we pulled up into what was intended to be a formation (albeit a loose one) loop, Tony suggested that Houdini roll away from us when he was vertical. This would give me a shot of the belly of his airplane, and would provide for separation as he did an Immelmann, while we completed our loop. I shot three pictures before Houdini rolled away and was gone. As we went over the top, Tony said; 'Hmmmm...70 knots...better see about getting the nose down.' His matter-of-fact attitude at being out of airspeed and inverted was more than just a testament to his experience. It was a measure of his confidence in the F-15. The Eagle didn't flop through, drop a wing, or show any tendency to surprise...the nose just fell slowly through the horizon, while the wings remained

level. It didn't take long to build airspeed on the back side of the loop, and we pulled out the bottom with better than 300 knots.

Casino One called to say that they were heading south, and that the fight was on. We were back in fluid two, and hoping the radar wouldn't let us down as our combined closing speed of over 1,000 knots made the fight imminent. Just as Casino closed to within 7 miles, a fairly significant cirrus cloud appeared at our twelve o'clock. It was significant, not because it was thick or extensive, but because it was solid, and while Casino One went under, Casino Two went above. One of the prerequisites for calling off the fight had been met, and the call to 'knock it off' came. Before another set up could be managed, Casino Two called bingo fuel, and Hendricks ordered Gimp to join up and head for Holloman.

One, Two, and Four got into a V, while we hung back so that I could feel the Eagle out. Tony demonstrated a couple of aileron rolls, then turned the controls over to me. I did an aileron roll to the left...nothing to it...just pull the nose a few degrees above the horizon and push (or pull) the stick to the side. The roll rate is fantastic! I didn't try any full displacement rolls, but after doing several rolls both ways, my roll rate had increased significantly. One of the neat things about jet fighters is that you can put your feet flat on the floor for most maneuvers when you have any airspeed at all. Roll control is via the ailerons, stabilators, (which move differentially to provide roll and symmetrically to provide pitch changes) and rudder. The Control Augmentation System (CAS) provides the same control inputs automatically for different airspeeds, longitudinal stick position, and gear position.

I asked how the F-15 did barrel rolls. (I like the barrel roll because it just seems kind of majestic — a big sweeping, positive G arc in the sky.) 'Like everything else,' Tony said, 'just great!', then demonstrated one. When he turned it over to me, my T-34 experience got in the way. I just couldn't seem to get it right for the first few attempts. Then Tony talked me through a couple more, with some hands-on coaching. All I had to do was put the formation (about a mile ahead of us) on one spot on the canopy, then keep them there as we rolled. Unfortunately, all of these aerobatics were burning our gas a lot faster than the rest of the flight, and we had to knock it off long before I was ready to quit. I had hoped to do some vertical maneuvers, but a glance at the totalizer was enough to show me that we would have pull into the formation for the rest of the flight home.

The few maneuvers I did weren't enough to do anything like an in-depth evaluation of the handling qualities of the Eagle, but I can compare it to the control pressures and sensitivity of general aviation airplanes. It is something like the difference between driving a truck without power steering at 10 miles an hour, and driving a Ferrari with power steering at 130 miles per hour.

The flight back to Holloman was smooth, though anticlimatic. The Sacramento Mountains slid into view, then Alamogordo. The beautiful white sands of the famous missile range appeared at our ten o'clock, then Hendricks called for trail. Houdini moved in tight on our wing, and we dropped two miles behind One and Two. As we turned on final approach, the gear and flaps came down, and the speed brakes popped up, which necessitated a power increase. Houdini stayed locked on our right wing as we slid down the localizer glide slope. As we crossed the overrun, Tony smoothly pulled the nose up to flare without changing the power setting. We would touch down about 10 to 15 knots 'hotter' than normal, but this would allow our wingman the necessary latitude to work with. We squeaked on, then Tony came back on the power, again smoothly, and as Houdini took a greater interval, we both started our Aerobraking.

The F-15 does not have a drag chute, or any high lift leading edge devices on the wings. It relies on aerodynamic braking and effective wheel brakes to stop. The tremendous wing and fuselage area do create a lot of drag when the nose is held off as the aircraft slows on roll-out. Touchdown is normally made at 110 to 120 knots, and aerobraking commenced immediately by holding the nose at a pitch angle of 12 to 13 degrees. (There is plenty of pitch authority at these speeds, and care must be taken not to over-rotate and scrape the afterburner nozzles on the runway.) The nose is lowered at 80 knots, and wheel brakes used thereafter. As we turned off at the end of the runway, Casino One and Two were waiting for us in the quick check parking area. We pulled in and everyone looked everyone else over.

"Say, you really got a bad gas leak...I can't tell if it's coming from the centerline tank or one of the engines, though." I was day-dreaming, and the impact of what I had heard didn't sink in right away. When it did, I wondered who had the fuel leak. Then I heard Hendricks say: "Let's knock off the discussion! Shut that thing off and get out of it...we'll send the Fire Department!" Tony came on the ICS to say that it looked as if we would have to hitch a ride back to the ramp. "YOU MEAN THAT WE HAVE THE FUEL LEAK!!?" "Yeah," he said, "but no big deal yet — no reason to panic — just unbuckle and we'll climb out and wait for the firemen." The engines were suddenly quiet, and the canopy hissed up, letting in a blast of JP-4 tainted hot air. Now let's see, how did that unbuckle drill go that I had during the seat briefing?...Oh yeah, one, two, one, two — that's lap belt and survival kit, then Crew 60 fitting and parachute risers. I finally did get

'Houdini' Rudin (left) and 'Tony' Mahoney. Do all F-15 pilots look like Jack Armstrong? (Answer: Only when they are around their airplanes...away from them they are mere mortals.) (Author)

everything disconnected, and looked around to see Tony reconnoitering back towards the rear of the airplane. He came back up on the ramp to warn me not to step off of the ramp. He needn't have bothered — I hadn't forgotten my own thoughts about having to see an orthopedic surgeon as a result of a misstep off the intake ramp. We walked back down the wing, carefully avoiding the 'No Step' areas, stepped down onto the left horizontal stabilator, and prepared to jump to the ground. Standing on the stab, we were only about 6 feet from the pavement, and the drop wasn't enough to worry about, even with my parachute-jump-damaged knees.

There was indeed an impressive fuel leak, and the JP-4 was rapidly spreading. Within minutes the Fire Trucks had arrived, and the silver-suited firemen had washed down the ramp with water. They stood by while the remaining fuel was drained and the F-15 was towed back to it's parking place, where the mechanics and McDonnell Aircraft technical representatives would open it up and trace the cause of the leak to a broken bolt on one of the fuel lines. Evidently the line had let go just as we landed, because no one had spotted a tell-tale vapor trail of a fuel leak while we were in the air.

We were lucky, but this non-incident points up the fact that flying fighters is perhaps one of the most dangerous career undertakings in the world. Hurtling through the upper atmosphere at supersonic speeds in twenty-five tons of steel, aluminum and titanium, with the weaponry to blow anything out of the sky, and a mission that requires pushing the man/machine union to it's limits requires a special kind of man. Fighter pilots have been celebrated as unique individuals within a military framework ever since the first combats in the skies over Europe during World War I. Seventy years ago the airplanes could kill you because the designers weren't quite up to speed on what the aerodynamic score was. They were pushing the outer edge of a very narrow envelope, and though the envelope has expanded dramatically, they are still pushing at the edges. Today's fighter pilot is smarter, quicker, and probably more disciplined (even though that sounds like an oxymoron) than ever before. They have to be to fly fighters with the capabilities of the F-15.

The author, postflight, but still not looking like Jack Armstrong.

49th TFW crewmen loading an AIM-7 Sparrow missile on the fuselage in June of 1980. (McDonnell Douglas)

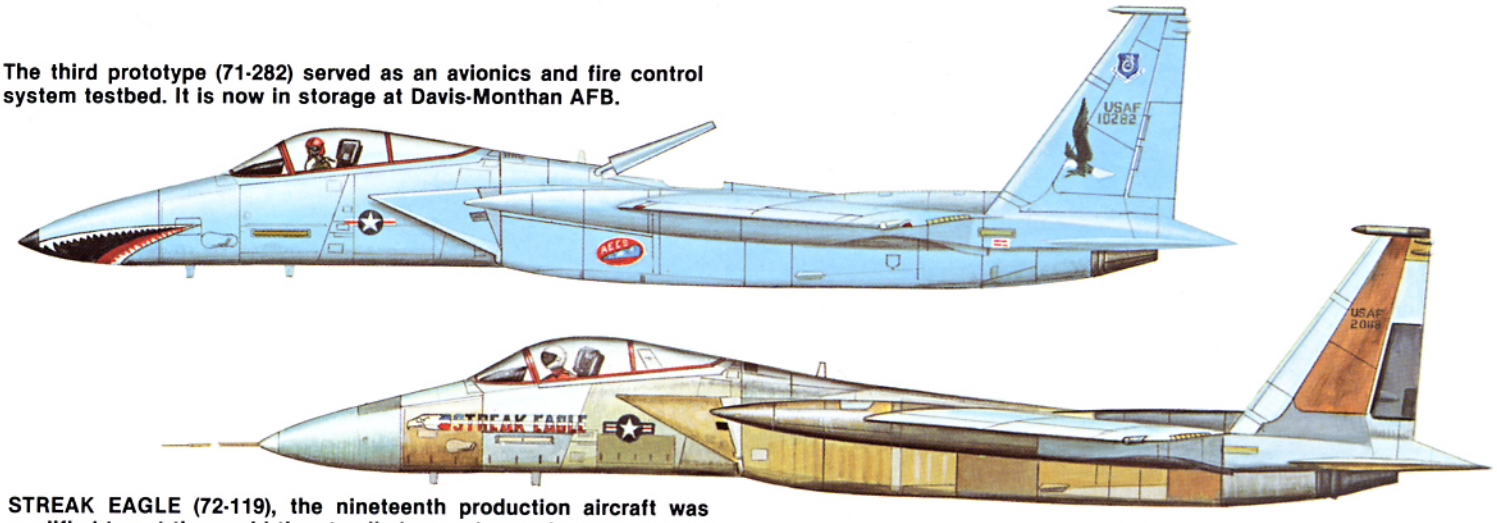
(Below) The Tactical Air Command emblem is carried on the top of the tail. (McDonnell Douglas)

(Above) F-15s of the 33rd TFW at Eglin AFB, Florida. (McDonnell Douglas)

(Above) 49th TFW (HO) personnel complete arming of this 8th TFS F-15A during a wing readiness exercise. (McDonnell Douglas)

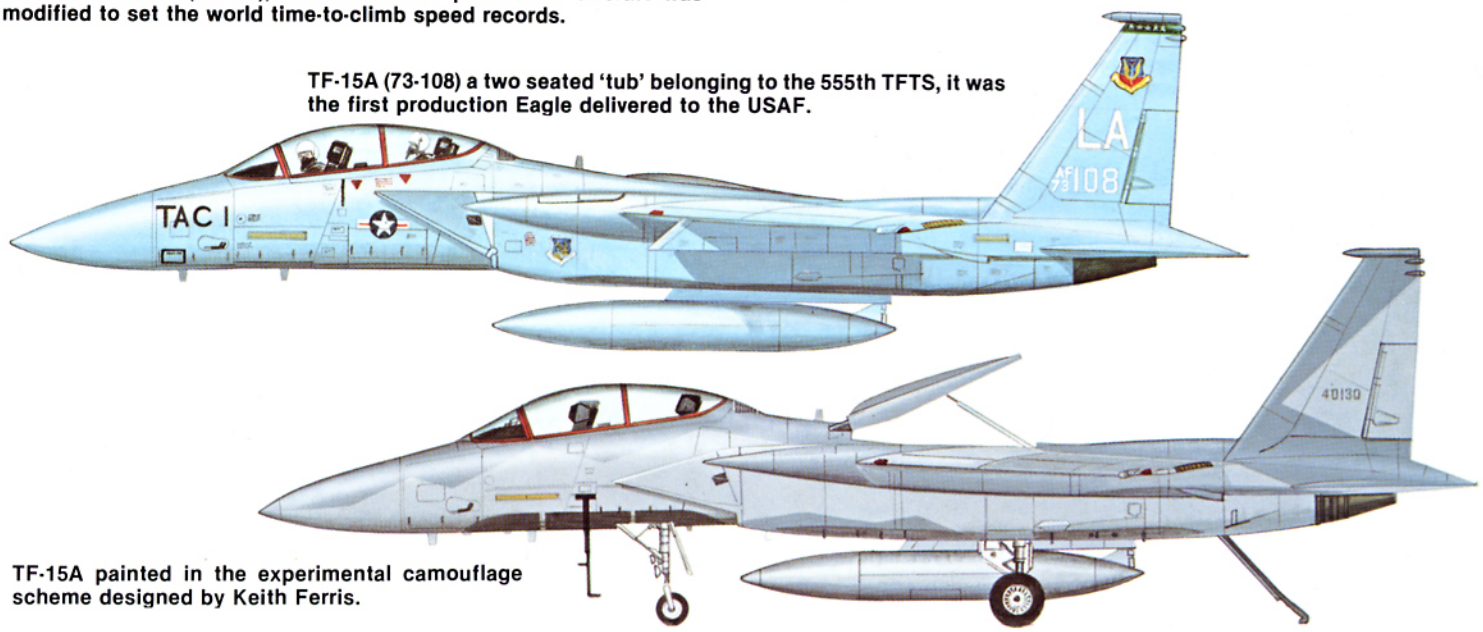
(Below) The 8th TFS ramp full of F-15s at Holloman AFB, New Mexico during May of 1980. (McDonnell Douglas)

The third prototype (71-282) served as an avionics and fire control system testbed. It is now in storage at Davis-Monthan AFB.



STREAK EAGLE (72-119), the nineteenth production aircraft was modified to set the world time-to-climb speed records.

TF-15A (73-108) a two seated 'tub' belonging to the 555th TFTS, it was the first production Eagle delivered to the USAF.



TF-15A painted in the experimental camouflage scheme designed by Keith Ferris.

F-15As of the 8th TFS, 49th TFW over the West Texas in May of 1984. The Compass Gray shadow camouflage scheme is seen to good advantage on these F-15s has become standard on the Eagle. (Author)

F-15B two seater of the 33rd TFW (EG) at Eglin AFB, Florida.

(Above) The 49th TFW 'Wing Airplane' is F-15-20-MC 77-149. Named 'City of Alamogordo' was singled out for special care and air show appearances because of its serial number. (McDonnell Douglas)

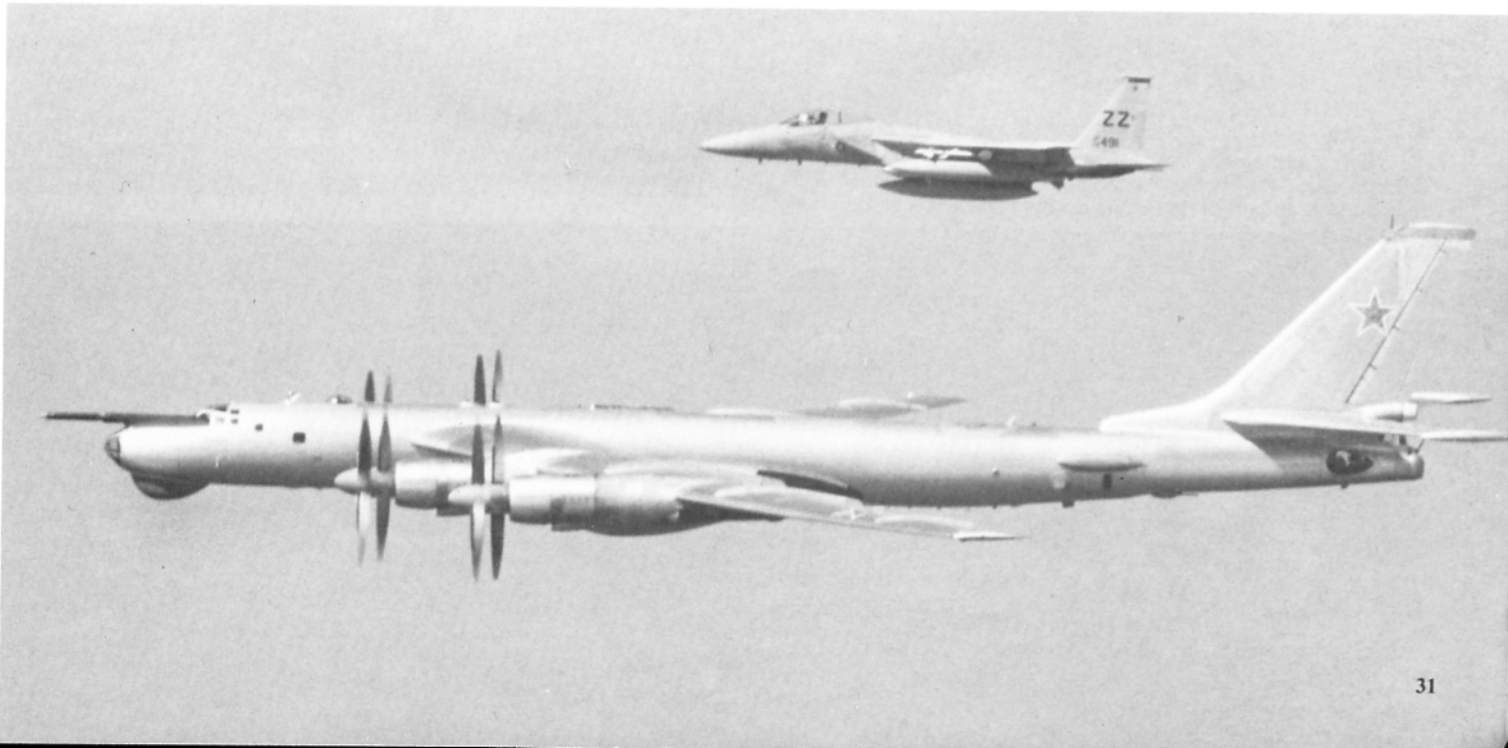
(Below) Crew Chiefs of 33rd TFW Eagles standby while the pilots go through their post-start checklists prior to taxiing. (McDonnell Douglas)

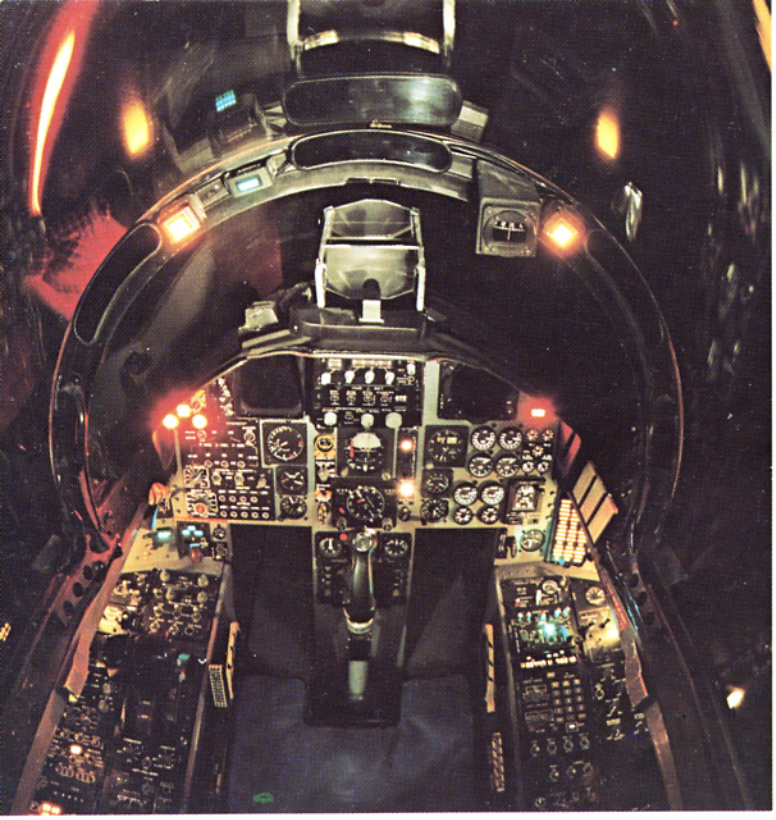
(Above) F-15A of the 18th TFW (ZZ) landing at Kadena AB, Okinawa. (Shinichi Ohtaki)

(Below) 18th TFW Eagle equipped in the relatively unusual long-range ferry configuration for the F-15A in September of 1979. The F-15C/D can be equipped with the FAST PACK conformal fuel pallets for long range flights. (McDonnell Douglas)

(Above) The 18th TFW is the only unit in PACAF to operate the Eagle. (McDonnell Douglas)

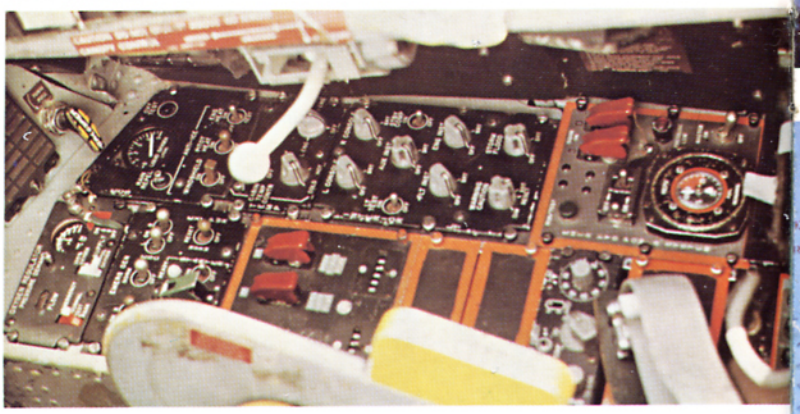
An F-15 of the 18th TFW escorting a Soviet Tupelov TU-95 Bear D which has intruded into Japanese airspace on one of the Russian's regular spy flights. (USAF)

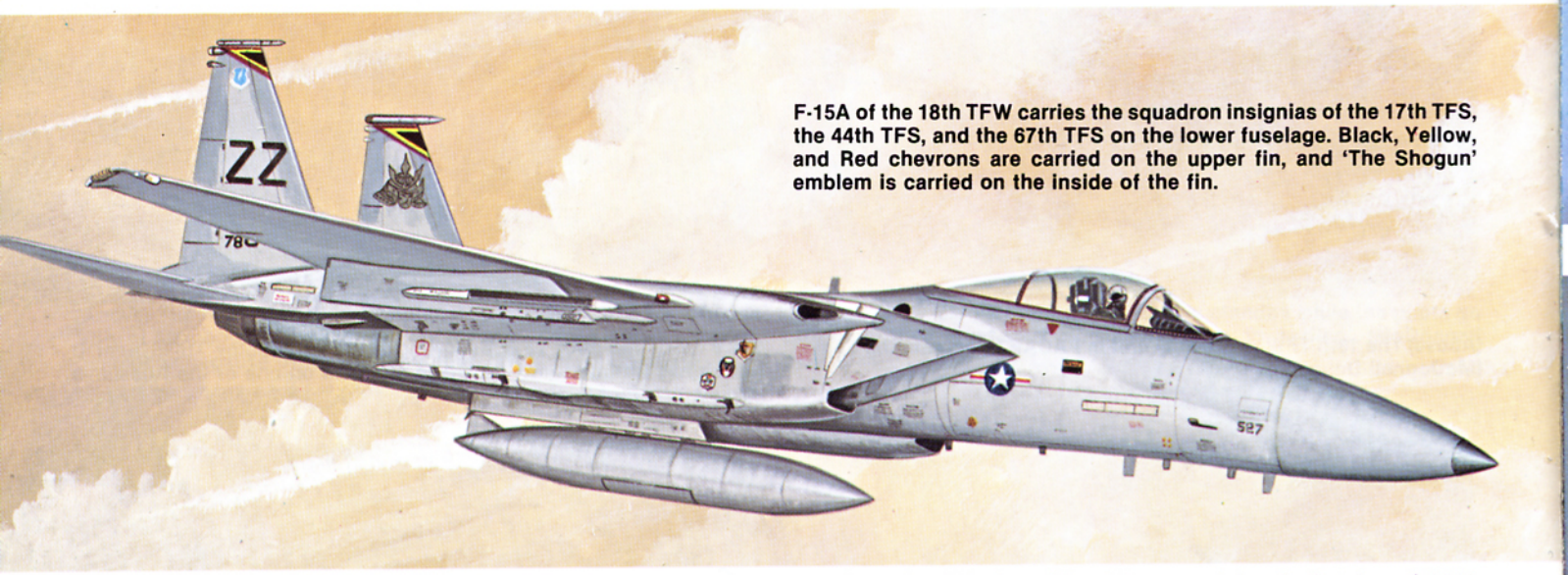




The F-15A Cockpit as it apeared in May of 1980. Everything the pilot needs during a fight is right in front of his eyes, with the Heads Up Display (HUD) being in the center of his vision. (McDonnell Douglas)

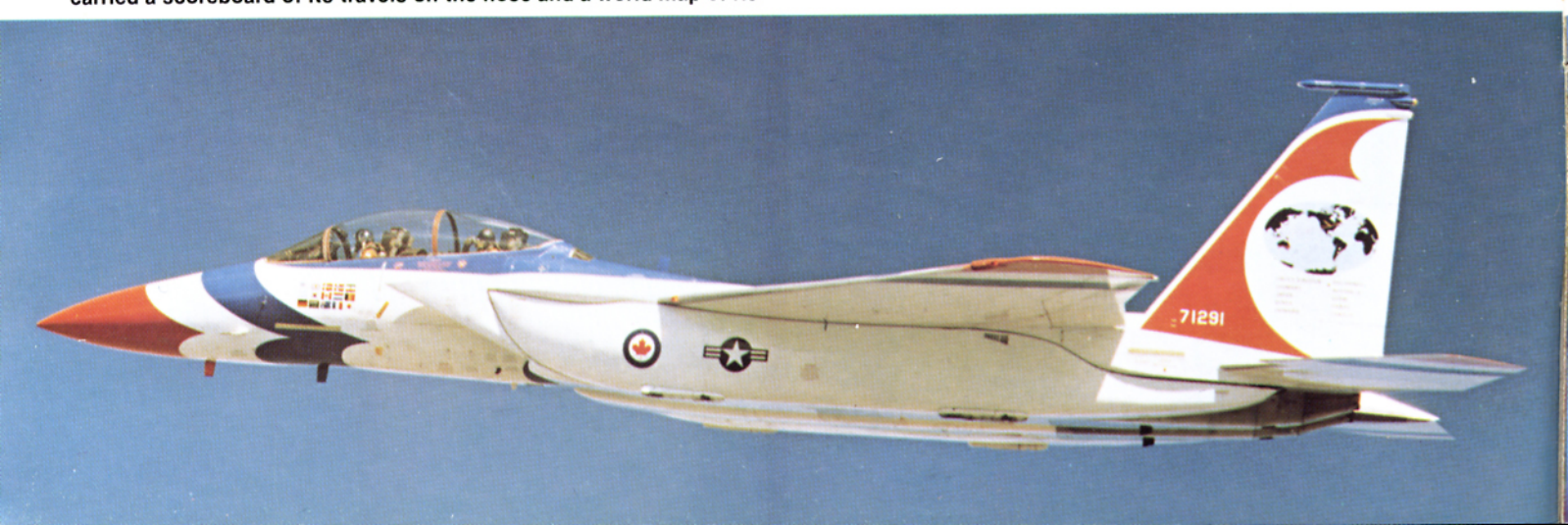
The cockpit of the prototype F-15A contained a number of flight test instruments unique to the test airplanes. These intruments were outlined in Orange to designate their non-standard nature. (McDonnell Douglas)





F-15A of the 18th TFW carries the squadron insignias of the 17th TFS, the 44th TFS, and the 67th TFS on the lower fuselage. Black, Yellow, and Red chevrons are carried on the upper fin, and 'The Shogun' emblem is carried on the inside of the fin.

The much modified and well traveled company F-15B was painted in Bi-Centennial (Thunderbird?) colors to celebrate our 200th birthday. It carried a scoreboard of its travels on the nose and a world map of its travels on the tail when this picture was taken in October of 1977. (McDonnell Douglas)



1st TFW — 27th TFS, 94th TFS, 71st TFS — 12th Air Force.

550th Tactical Fighter Training Squadron (TFTS).

33rd TFW — 58th TFS, 59th TFS, 60th TFS — 17th Air Force.

32nd TFS, 17th Air Force.

Air Defense (TAC) (ADTAC).

(Above Left) USAF TAWC, Eglin AFB, Florida.

(Above) 48th FIS.

(Left) 8th TFS.

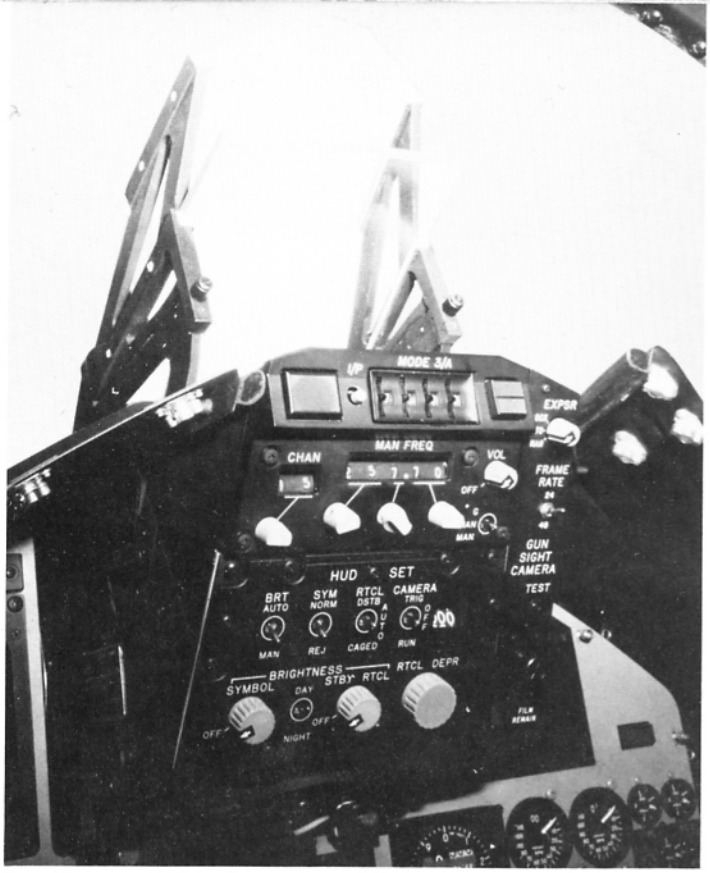
(Right) F-15C of the 32nd TFS, Camp New Amsterdam (Soesterberg AB), Netherlands. (McDonnell Douglas)

(Above) F-15A of the 36th TFW (BT) is fully armed and carries a centerline fuel tank.

(Below) In OPERATION READY EAGLE the three squadrons of the 36th were trained at Langley AFB, by a cadre of the 1st TFW, then deployed to Bitburg AB, Germany when they were operational.

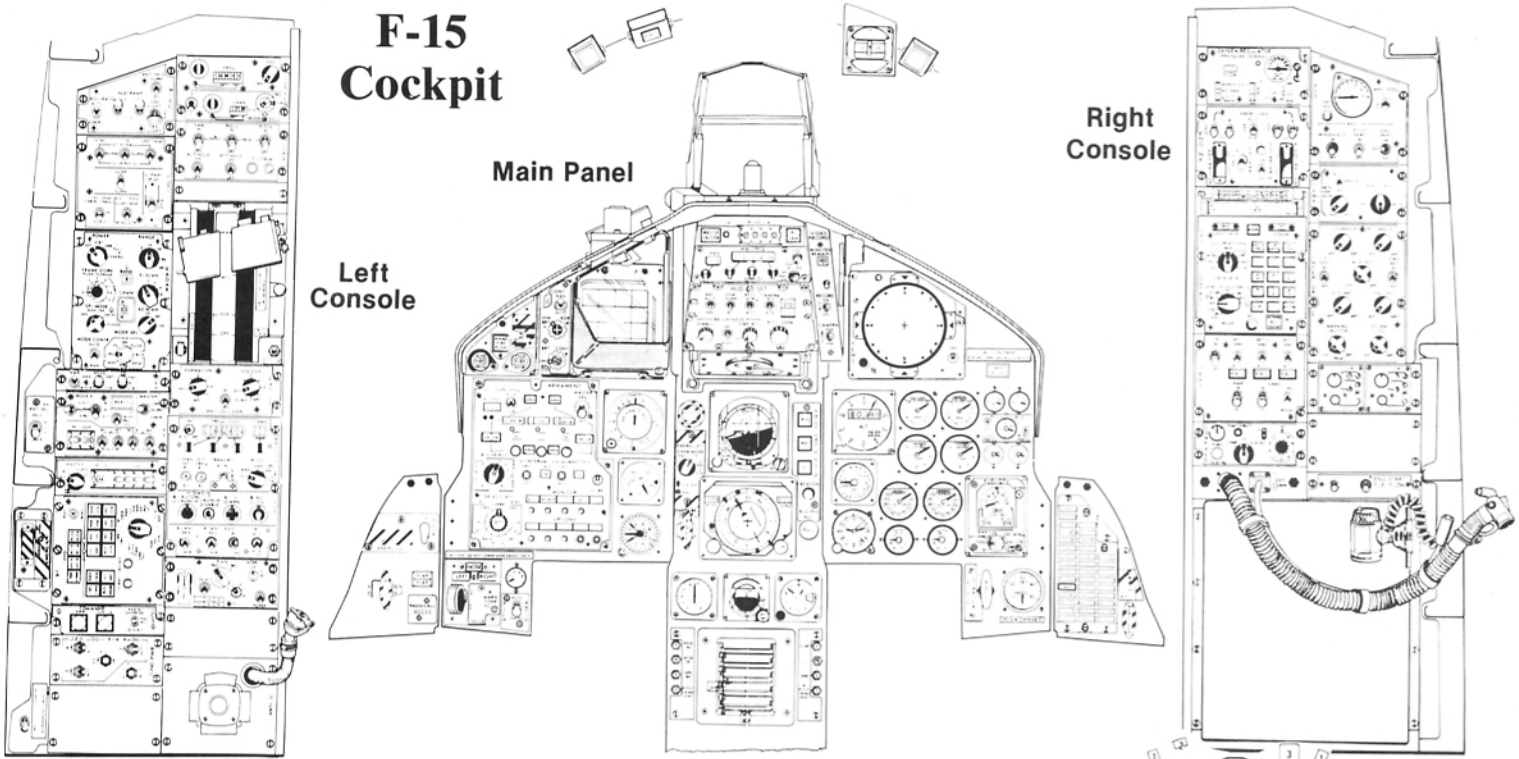
(Above) The 36th was the first USAFE Eagle Wing, achieving mission ready status in 1977.

(Below) The 36th has since turned in its A and B models for newer C and D models.



The standard F-15 instrument panel (Above) contrasted with that of the first F-15, as equipped for the flight test program (Right). The standard panel set up has the IFF (transponder) at top, with UHF COM radio next, and finally the HUD controls. Their location ensures that the pilot does not have to look into the cockpit for the necessary switches during air combat. (McDonnell Douglas)

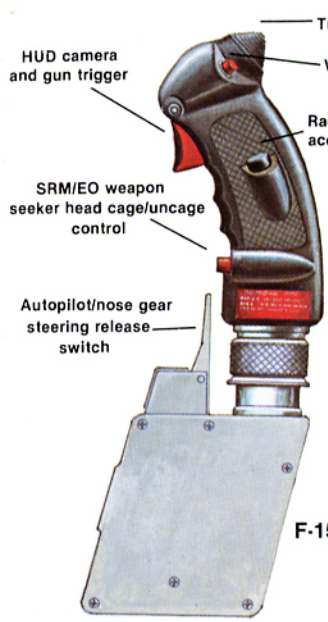
F-15 Cockpit



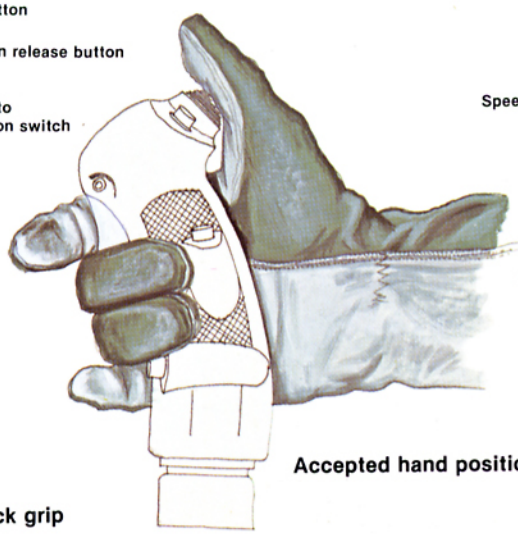
1. LOCK/SHOOT LIGHTS (SOME AIRCRAFT)
2. AIR REFUELING READY LIGHT
3. STANDBY MAGNETIC COMPASS
4. HEAD UP DISPLAY COMBINING GLASS
5. HUD VIDEO AND MICP CONTROL PANEL CAMERA
6. MASTER CAUTION LIGHT
7. MAIN COMMUNICATIONS CONTROL PANEL
8. FIRE WARNING/EXTINGUISHING PANEL
9. VERTICAL SITUATION DISPLAY (VSD)
10. HEAD UP DISPLAY CONTROL PANEL
11. VIDEO TAPE RECORDER CONTROL PANEL, BLOCK 24 AND UP:
    GUN SIGHT CAMERA CONTROL PANEL, THRU BLOCK 23
12. TEWS DISPLAY UNIT
13. CANOPY UNLOCKED WARNING LIGHT
14. HYDRAULIC PRESSURE INDICATORS
15. ENGINE TACHOMETERS
16. ALTIMETER
17. FAN TURBINE INLET TEMPERATURE INDICATORS
18. ENGINE OIL PRESSURE INDICATORS
19. FUEL QUANTITY INDICATOR
20. ENGINE FUEL FLOW INDICATORS
21. VERTICAL VELOCITY INDICATOR
22. EIGHT DAY CLOCK
23. ENGINE EXHAUST NOZZLE POSITION INDICATORS
24. JET FUEL STARTER CONTROL HANDLE
25. CABIN PRESSURE ALTIMETER
26. CAUTION LIGHTS PANEL
27. EMERGENCY VENT CONTROL HANDLE
28. CIRCUIT BREAKER PANELS
29. COCKPIT COOLING AND PRESSURIZATION OUTLET
30. STANDBY AIRSPEED INDICATOR
31. STANDBY ATTITUDE INDICATOR
32. STANDBY ALTIMETER
33. RUDDER PEDAL ADJUST RELEASE KNOB
34. MASTER MODE CONTROLS/MARKER BEACON PANEL
35. ATTITUDE DIRECTOR INDICATOR
36. EMERGENCY JETTISON SWITCH
37. STEERING MODE PANEL
38. HORIZONTAL SITUATION INDICATOR
39. EMERGENCY BRAKE/STEERING CONTROL HANDLE
40. ACCELEROMETER
41. ANGLE OF ATTACK INDICATOR
42. AIRSPEED/MACH INDICATOR
43. ARMAMENT CONTROL PANEL
44. PITCH RATIO INDICATOR
45. PITCH RATIO SELECT SWITCH
46. LANDING GEAR CONTROL HANDLE
47. RADIO CALL PANEL
48. FLAP POSITION INDICATOR
49. EMERGENCY LANDING GEAR HANDLE
50. ARRESTING HOOK CONTROL SWITCH

(Above) F-15A of the 36th TFW over Norway during 'Artic Express 78', a multi-national combat readiness exercise designed to test operational efficiency under artic conditions. (USAF by SSGT David E Shaffer)

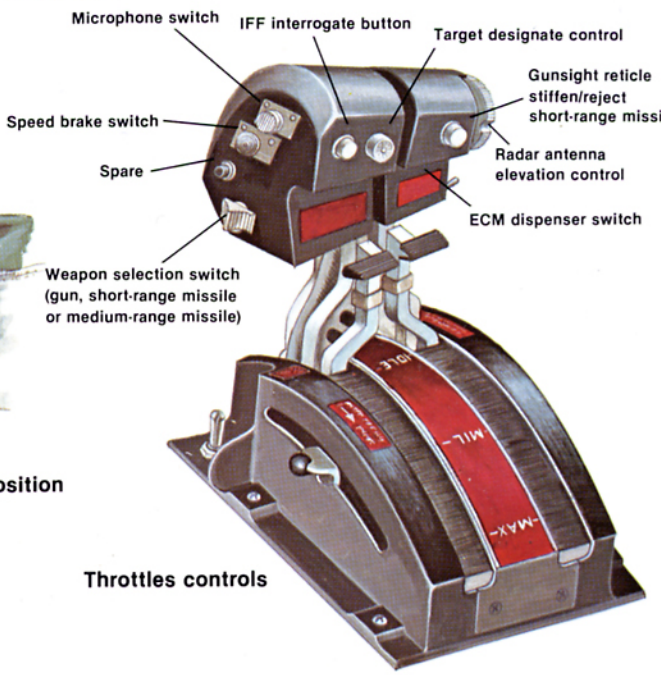
(Below) Where the 'Ego Jet' got its name — high in the skies over central Europe, site of aerial battles of the past, an F-15 of the 32nd TFS patrols under NATO control. (USAF)


Trim button
HUD camera and gun trigger
Weapon release button
Radar auto acquisition switch
SRM/EO weapon seeker head cage/uncage control
Autopilot/nose gear steering release switch

F-15 Stick grip

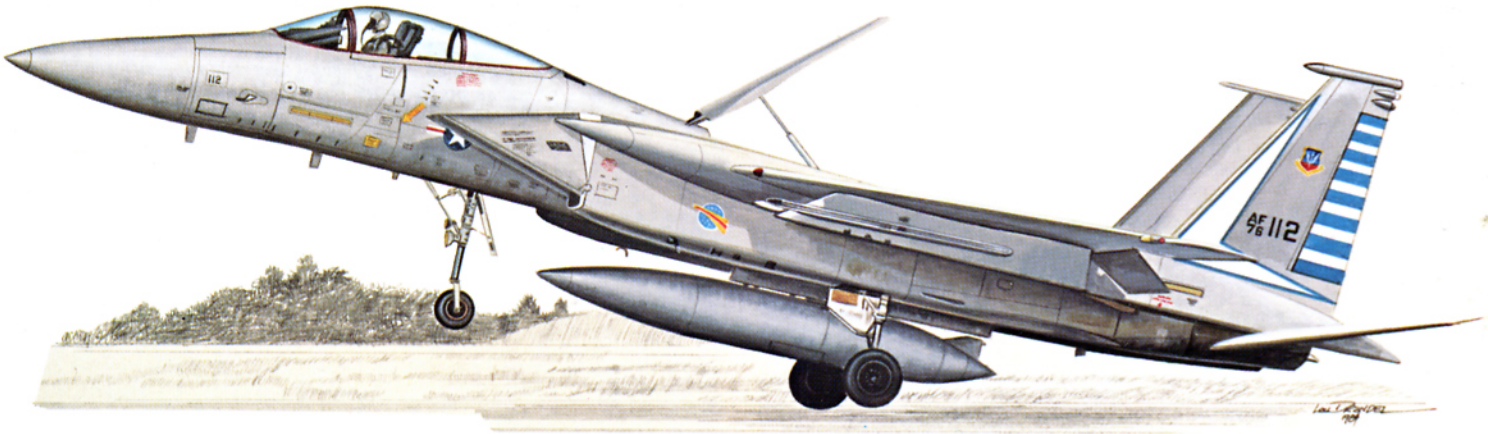


Accepted hand position



Throttles controls

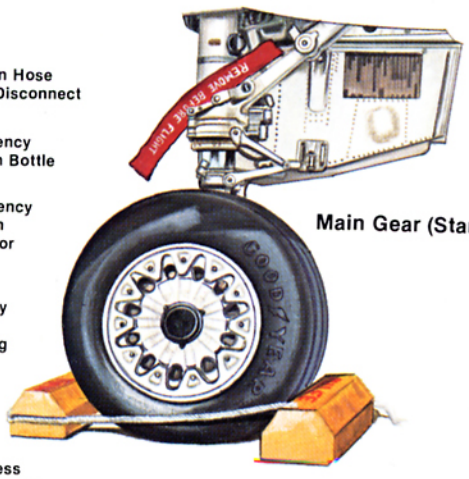
The HGU-33/P helmet (Left) has given way to the lighter HGU-55/P (Above), which is now the standard among USAF F-15 pilots. Its lighter weight enables the pilot to pull more Gs for longer periods without tiring.



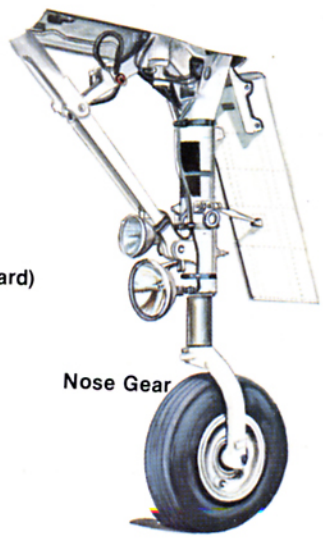
(Above) F-15A of the 48th FIS landing. The F-15 does not employ a drag chute but is dependent on aerodynamics and brakes.

McDonnell Douglas Aces II Ejection Seat.

LANDING GEAR



Main Gear (Starboard)



Nose Gear

EAGLE PILOTS

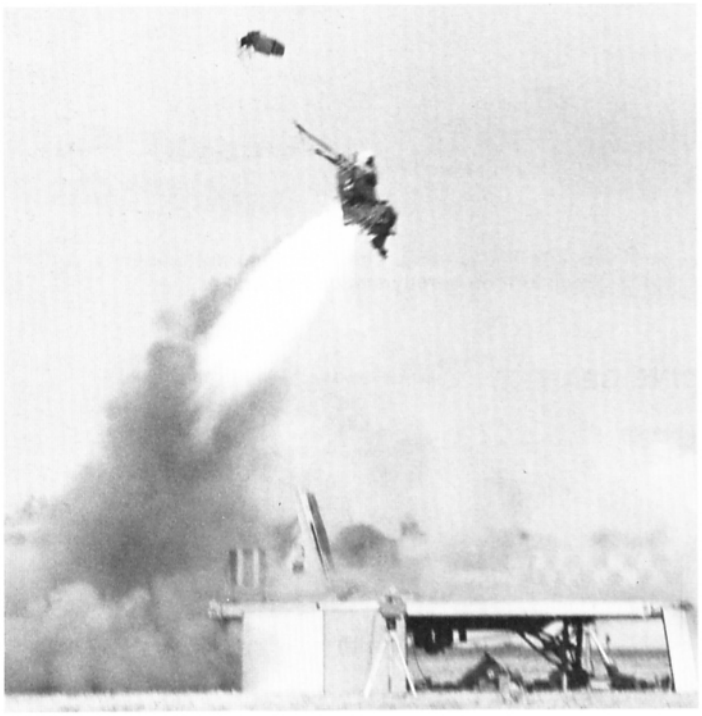
Flying fighters in the air-to-air mission may be an art, as Lt Col Dave Rickert maintains, but it is also a science, and there is a lot of headwork involved in the F-15 mission. A group of high-time F-15 pilots agreed to share with me their thoughts on the airplane and the mission. Since there were over a dozen pilots in the room, and many of them provided answers to the same questions, I have taken the liberty of treating their answers as if they came from one.

There are two F-15 bases in Europe, and USAFE is a much sought after assignment. I wondered how the flying in Europe differed from that in the United States. *Obviously, the biggest factor is the weather. Its always cloudy in Europe, and its always clear here (at Holloman). The weather is one of the dominant factors in everything you do over there. You have all the interaction with the other NATO countries...you can't just go blastin' off through the countries...they all have different rules. Their pilots are all different levels of proficiency...their airplanes are all different levels of effectiveness. There are more operational deployments too...we'll go to the ACMI range, up to England where we fly out over the North Sea, or we'll go fly with the French. One squadron that we have here on the base goes to Denmark, a country they will support if war breaks out. That's a large part of what makes flying in Europe a lot different than here in TAC.* I wondered if they flew with or against the other NATO pilots. *Well, I have done both.* And how do they stack up? *It's tough to compare the F-15 to the F-104, but for the most part they do a good job with what they have available.* Do you fly against the French? (France pulled out of NATO during the DeGaulle years.) *I've only flown against the French — not with them. I have flown against the Pakistanis when we were over there...they have the Mirage V, F-86, and the Chinese F-6, a Chinese-built copy of the Russian Mig-19. That was kind of interesting, though they are at least eight to ten years behind us tactically...still very rigid, like most countries in the Mid-East (Israel excepted). They just don't do anything that's off the wall. We had some interesting flights over in Korea. We had some very large outnumbered sorties. For instance we flew four versus twenty-four, or eight versus fifty-eight. Those were against the South Koreans, or against the US Navy or PACAF USAF units with F-16s or F-4s. That's a lot better training for us, because its like it would be if you went to war. You never knew how many airplanes you would be up against in the strike package. Here, when you're up against two opponents and you see them both you have it made. There, you never knew how many you would have to fight. You have another artificiality here in that you never start the fight until your'e ready to go...with all your switches set up, etcetera...then you say, "O.K. let's fight". But in an exercise like Red Flag, or like the ones we flew in Europe or Korea, you had to be ready to fight as soon as you got the gear in the well.*

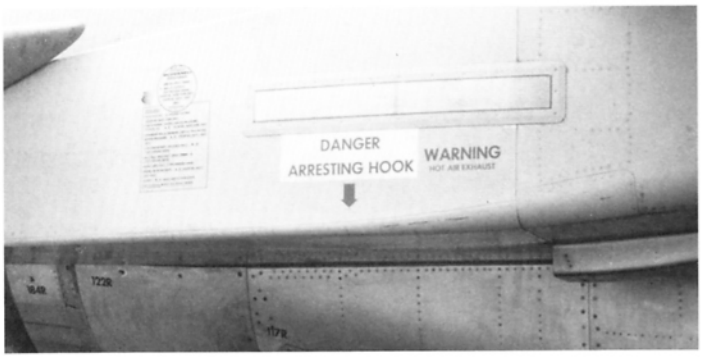
We had our own exercise here, which we called 'Bushwacker'. You would be sent out to CAP a certain point, and you never knew if there would be nobody coming through, or if there would be 50...it was really interesting, and wartime realistic. That's good training, and we try to do as much of that as we can.

Since the Israelis were the first to use the Eagle in combat, and produced several F-15 aces, I wondered what kind of feedback our F-15 units had received from Israel. *Well, we have not received any official feedback, and it's almost impossible to get unofficial feedback, because we don't have any contact with those people. Obviously, you can see by reading the papers that they have done extremely well. A lot of that has to do with them, and a lot has to do with their opponents. I mean, when you talk about Syrians, you're not talking about your typical steely-eyed killers. Some of the Israelis came through here a few months ago, and they were more interested in learning what we knew about the airplane than they were in passing on anything they had learned. We were not really ready for that, since we assumed that their success in actual wartime conditions meant that they didn't need our input. But you're always trying to find out what the other guy is doing so you can put it in your bag of tricks.*

Some of these pilots had flown combat in Vietnam. I asked one of the former F-4 pilots what difference the F-15 would have made. He smiled, and said: *I'd probably be an ace. This airplane (the F-15) is about two steps in technology beyond the F-4 as far as maneuverability, power, avionics, and visibility — lookin' out the cockpit type visibility. The ordnance is much better too, the newer AIM-7s and the AIM-9L are much better, and cockpit switchology is a vast improvement. You take the whole package — the capabilities of the F-15 versus the F-4, plus the training we get today compared to the training we got then — it's just an overwhelming difference. The pilots today are trained so much better than they were during the Vietnam era. In my opinion, the guys in TAC today can go straight to combat and do good. You know, another thing about our training...we are the first guys who are dedicated exclusively to the air-to-air mission. That's all we do, and*



Testing of the McDonnell Douglas ACES (Advanced Concept Ejection Seat) at the Long Beach California testing facility. This test used an anthropomorphic dummy, and the seat was fired at zero airspeed and altitude. In addition to zero-zero capability, the ACES II seat permits a safe ejection up to 50,000 feet, at over 600 knots, or while flying inverted at 200 feet! This McDonnell Douglas seat is also used in the General Dynamics F-16 and Fairchild A-10. (McDonnell Douglas)



Night formation strip light on rear the fuselage.

The Arresting hook and exhaust control hardware.

we do it everyday.

The Eagle squadrons regularly get pilots who are fresh from pilot training. I wondered how much actual experience they had before they started flying with the squadron, and how well they did in the more realistic training exercises. *Let's see, they will have about 180 hours when they come out of training, then they come here for Lead-In Fighter training in the T-38, then they get about sixty hours in the F-15 with a training unit, so they probably have between 250 and 300 hours total time when they join the squadron. We have had people with less than 100 hours in the F-15 go to Red Flag with us, and they generally do pretty good. We don't just throw them into the breech though... we'll marry up the inexperienced guy with somebody like Tony who has 1600 hours in an airplane. This kind of training is so much better than what we had during Vietnam. Back in those days, there was no Red Flag, no Maple Flag... no flag of any kind... we would only fly against each other, which in some cases was almost negative training. You went out with a four ship flight, went two V two, and everyone ended up at low altitude, with the stick in their lap and full afterburner. Then you knocked it off and started over again. We were sending kids over to combat that just weren't ready. Then in 1972 we got some commanders that said: "Let's get serious about training." We got the Aggressors, and that was really the beginning of what has turned out to be the largest quantum leap in training history.*

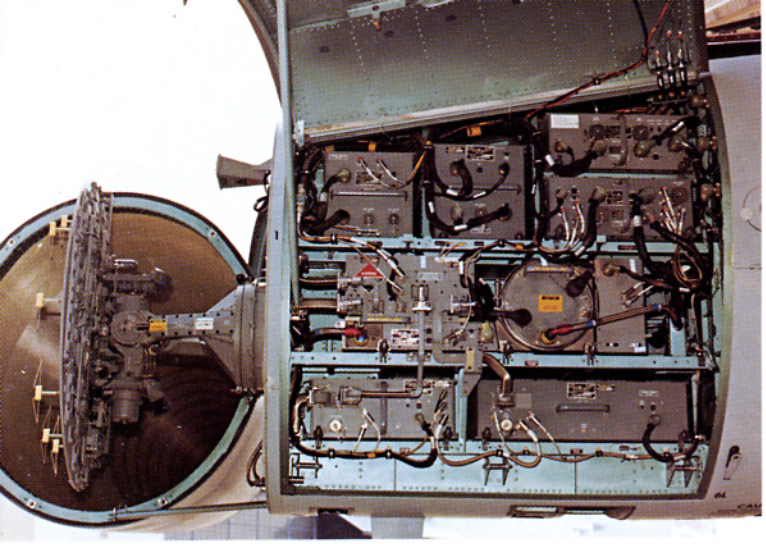
I ventured the opinion that the capability of the airplane must have a lot to do with how much better our pilots are today. Oh yeah, its an easy airplane to fly, but it's difficult to employ. You may not have to worry about flying so much, but you sure do have to consider all the ways in which to employ the capabilities of the airplane. With the F-4, you had to worry about flying it first, then employing it. The F-15 is not difficult to fly, but one of the drawbacks to that is that a kid gets out of pilot training, and has never had the airplane in a situation where he might have to do something a little different to survive. Well, if the F-15 is easy to fly, it must not be the kind of an airplane that will put you into a corner. *Oh, you can get it in a corner, but you have to put it there. Look at the accident rates for fighters... The F-15 rate is 4.7 per 100,000 flying hours, while the F-16 is 16 or 17. Now, some of that is the mission. After all, we are not running around at a hundred feet, as fast as we can go, for twenty or thirty minutes at a time like some of the other fighters, and you are a lot more likely to run into the ground when you are flying that close to it, that fast. But the F-15 is just built well too. I had over 600 hours in the jet before I had my first emergency, and that was a hydraulic problem. Its very forgiving, and its very redundant. For example, we have a fly-by-wire system. But we also have a hydraulic system, so if one fails, we have the other. The F-16, on the other hand, only has the fly-by-wire... sure, it's redundant, but if you have an electrical failure, you lose them both. I'm sure that has something to do with the good accident rate too.*

I wondered if any of these pilots had spun the F-15. *A lot of people have spun the airplane, but its usually because of a fuel imbalance, or a failed system... something that gave them the moment that got them into a spin. During testing they discovered that they had to fail three systems to get it into a spin, so its really pretty spin-resistant. You can take an airplane right off the line here, take it up and try to spin it — you probably won't be able to. Even at Edwards, they were only successful about half the time in getting it into spins. Half the time it would recover by itself... you couldn't force it into a spin. I'm sure everyone here has been to zero airspeed, and it's no big deal.*

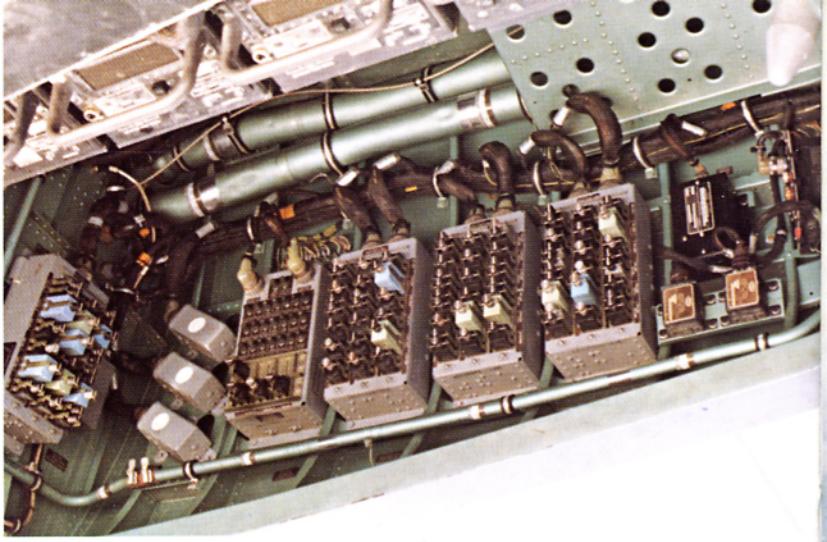
Flight instruments are subordinated to radar, HUD, and communications displays on the upper instrument panel, which is a certain indication of the importance of head-out-of-the-cockpit VFR flying in the F-15. (McDonnell Douglas)

The contrail of a just-fired Sparrow missile is converging on the contrail of a target drone miles in front of this F-15. (McDonnell Douglas)

(Below and Right) Ease of maintenance of the F-15 is evident in these photos, which show all of the Eagle access panels opened. (McDonnell Douglas)

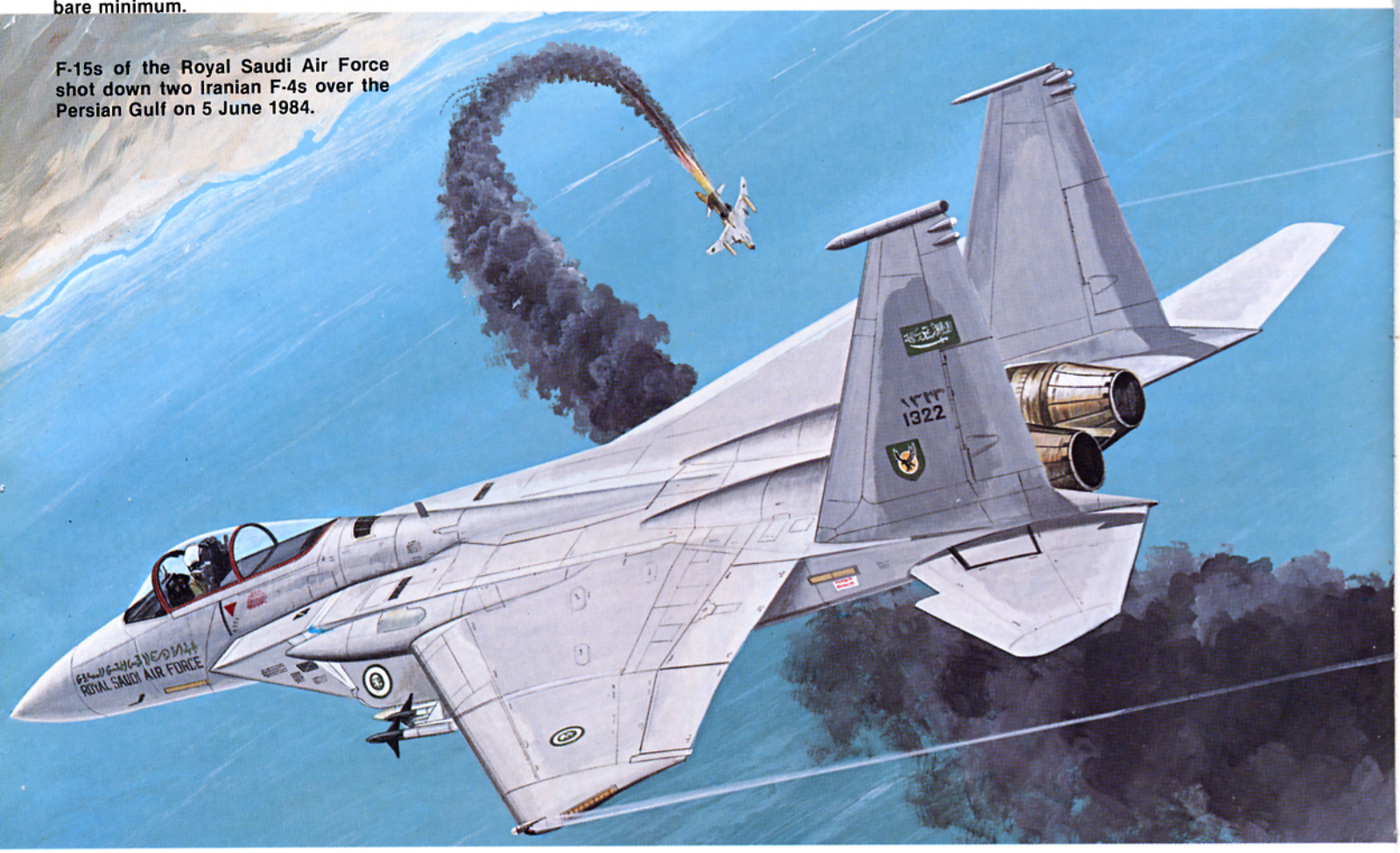


APG-63 radar. The plug-in 'Black boxes' reduce maintenance time to a bare minimum.



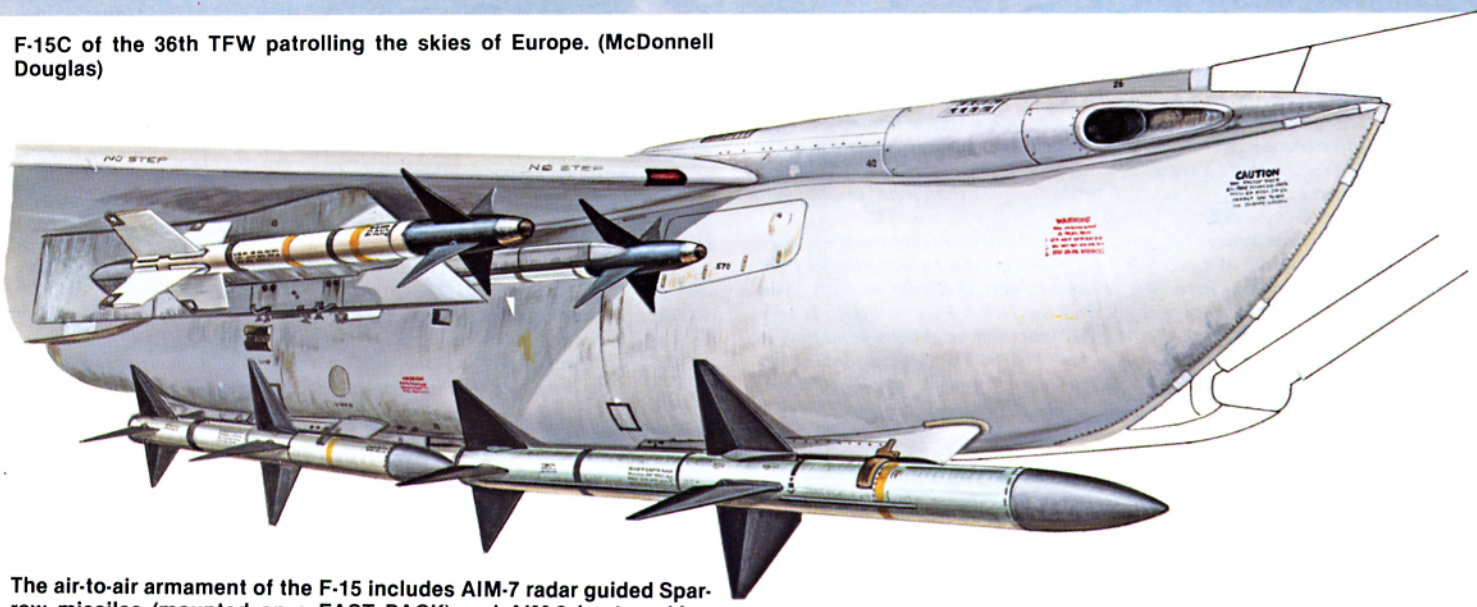
The Avionics bay behind the ejection seat of the F-15A.

F-15s of the Royal Saudi Air Force shot down two Iranian F-4s over the Persian Gulf on 5 June 1984.

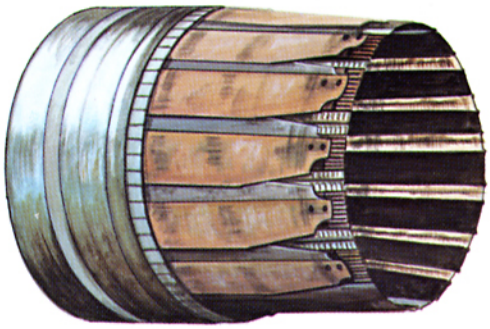


(Below) The first F-15C, equipped with inert AIM-9s, MK 82 bombs, and FAST PACK fuel pallets, during a test flight out of Edwards AFB in August of 1983. (McDonnell Douglas)

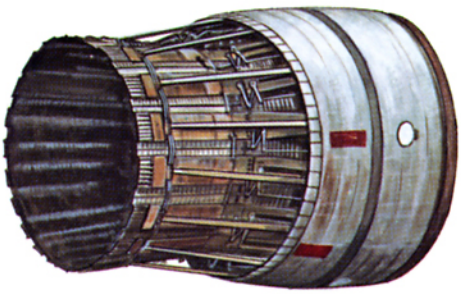
F-15C of the 36th TFW patrolling the skies of Europe. (McDonnell Douglas)



The air-to-air armament of the F-15 includes AIM-7 radar guided Sparrow missiles (mounted on a FAST PACK) and AIM-9 heat seaking Sidewinders (mounted on wing pylons).



Exhaust equipped with 'Turkey Feathers'.



Eagles now have shed the 'Turkey Feathers' from their exhaust pipes.

Israeli F-15 with four kills - all Syrian Migs. Name "Skyblazer" on nose in Hebrew.

Comparing it to the F-4, one of the things I noticed right away when I got into the F-15 was your nose track across the horizon, in degrees per second. Plus, you can be going along at 450 knots, plug in the afterburner, pull six Gs, and climb or accelerate! In the F-4, the stick was connected to the airspeed indicator. If you pulled, you knew the needle was going to wind down.

Well, I asked, was it possible to depart (controlled flight) the airplane? *No. You can get what's known as an autoroll. That's not a violent maneuver, and is easily recovered from with control inputs against the roll...its actually self-recovering if you wait long enough. I don't think an autoroll is hard to get into, but again, you have to be kind of unaware of what's going on in order to get into it. The F-15 gives you lots of signals too, so you know if you're about to get into one of these things.*

Is there any difference in control feel between sub and supersonic? *No, and that's a lot better than the F-4. I flew hard wing Phantoms (no automatic leading edge flaps), and you would get a lot of different control effectiveness in the transition going through the Mach.*

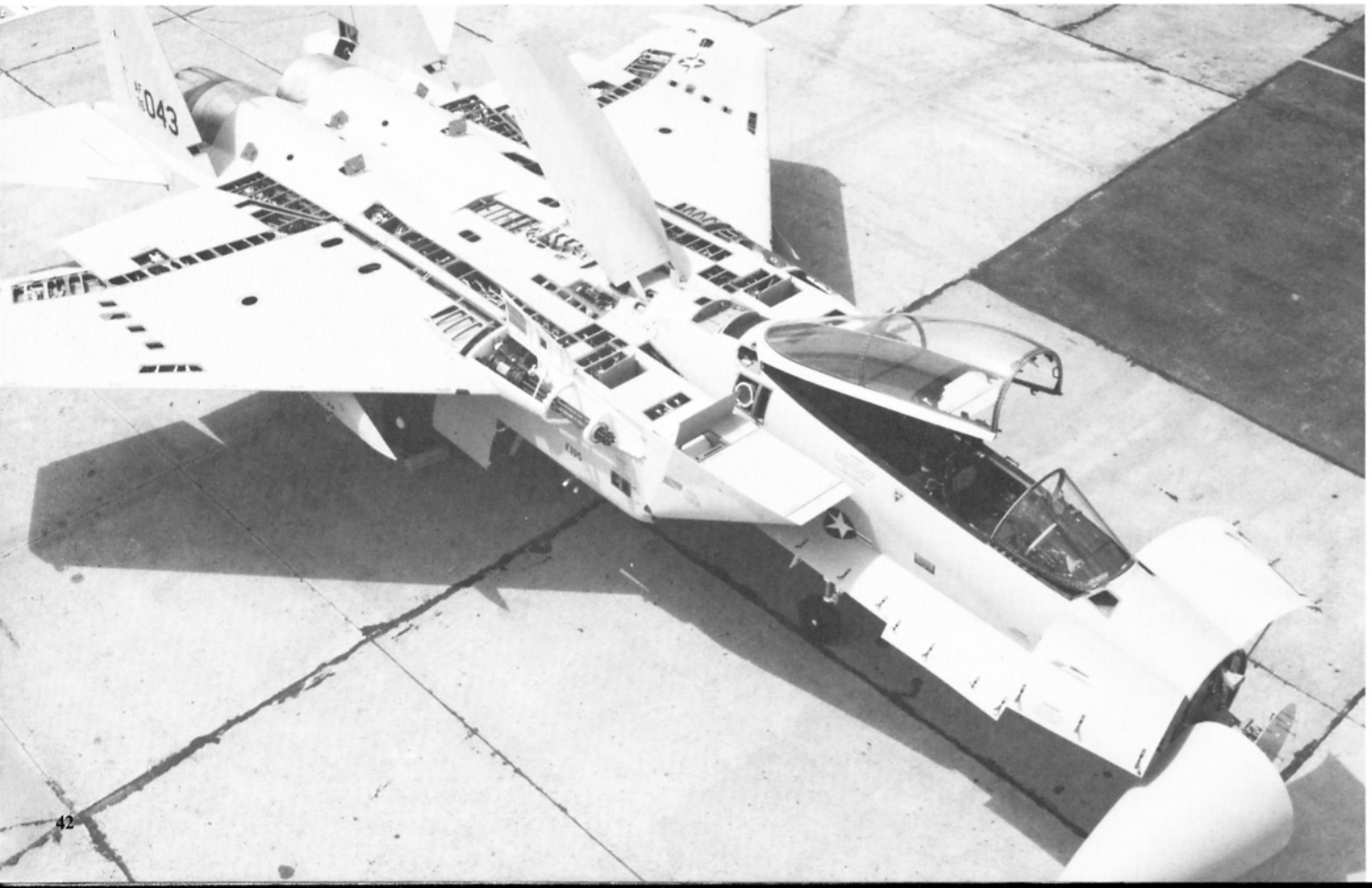
The F-15 is replacing the F-106 in the air defense role, and there are several ADTAC units, with more to come. I asked these pilots what they thought of that mission. *You won't find any volunteers here for that mission. Its a really ho-hum mission, compared to going out and fighting other fighters, maybe 4 V 48 or something like that. The F-15 does the ADTAC mission very well...too well. What I mean is, here we have this fantastic GCI network, and those guys are used to controlling the F-106 almost right up until its time to shoot. Now they get F-15s to control. They'll turn the F-15 towards a target 40-50 miles away, and the F-15 picks the target up on its radar and can complete the intercept without any GCI assistance. So, what do you do with the GCI? If you want to retain that capability, you have to keep those guys sharp by letting them control the interceptors. That means the guys flying the airplanes don't train the way we do, and are not as sharp on the radar. The mission itself is different. That mission is a 'defense of the homeland' type mission, where there is no threat from the ground. When we deploy, we are going over THERE. We'll have to deal with SAMs, triple A, enemy fighters, and hostile terrain, so its much, much more complex than flyin' around gettin' turns from GCI, rollin' out behind somebody and shootin'.*

Our training is much more tactically oriented, and there is more of an 'edge of the sword' attitude. We feel we'll probably go somewhere else to fight before anything happens here. We just don't feel that that mission...you know, the old 1950s 'Here they come over the North Pole' scenario is very valid today. I also don't think the ADTAC units will be able to stand having an airplane like the F-15 and not doing more with it. They will probably start doing more dissimilar, and ACBT...so that mission is likely to change some. Trouble is, they'll go up and do that for a week or so, then go and sit alert for a month.

There are other missions on the horizon for the F-15. There is the F-15E Strike Eagle, which the Air Force is committed to, and still in the experimental stages, the ASAT (Anti-satillite) Eagle. How about those missions? *Well, that's a whole different ball game. The airplane's the same shape, but all the avionics are different. The Air Force will probably have squadrons dedicated to each of those missions. They are that much different, that you could not incorporate them into this squadron...just support-wise. The parts are so much different, especially the avionics.*

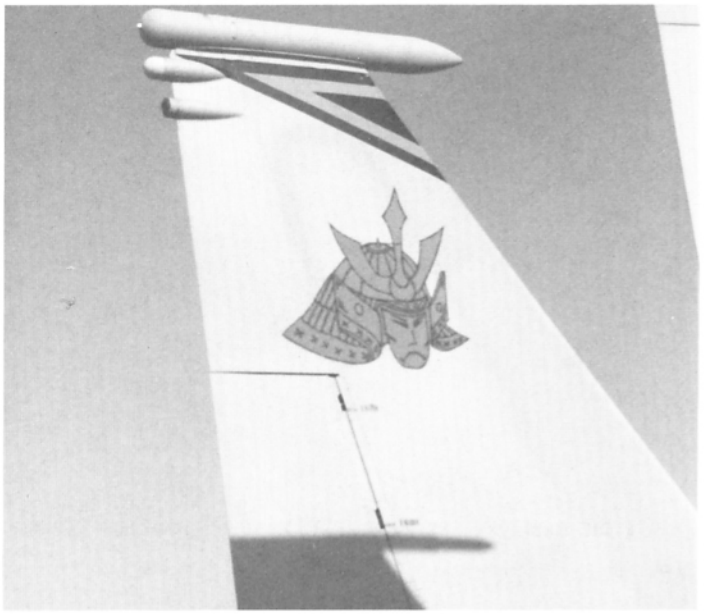
So you believe that the specialization will continue? *Hopefully, and hopefully we will get to stay in air-to-air. The air-to-air mission is something that's totally different every time you go out to do it. You could never stay proficient by flying once a week. You have to fly every day to stay proficient at working the 'piccolo'. ('Piccolo' is a term used to refer to the multiplicity of weapons, radar, communications, and jamming switches mounted on the stick and throttles of the F-15. It takes considerable manual dexterity to employ all of the F-15's capability, and like a concert musician, you have to practice to be good.) There are almost no two missions that are ever the same because of the three dimensional aspect of the situation. In the F-4, after a couple of years, you really knew the mission, because nothing really changed. Oh, they might add Pave Spike, or Maverick, but those kinds of changes didn't happen every day. With the F-15, you are always reading or studying some new software program for the computer. There have been four generations of computer software since I have been in the airplane. If you take a break for three or four weeks, you will not only not be proficient, you'll be dumb on top of that! If you wanted to change something in the F-4, you had to put the hardware in. In this airplane, you can make big changes just by changing the computer tapes. You can compare the increase in the capability of the F-15 in the same way you might compare computers. Memory capacity has gone from 8K to 16K to 48K to 128K and on and on. But the threat changes, so we have to try to stay one step ahead. A classic example of that was demonstrated last year. When we go flying, we put all these airplanes in a four ship 2 V 2, for example, and we put them all on different radar channels. The Air Force decided that we needed some practice with some radar channels jammed. The tape with the jammed channels came into the squadron and we were briefed, but a couple of the guys didn't get the word. Well, they were just jammed all day long, and suffered the consequences.*

Would you consider the F-15 the best fighter flying? *In my opinion it is. If I had to go to war, this is the airplane I want to go in, and that's the ultimate compliment I can pay any airplane. With our avionics and weapons, it would probably take you about one mission to become an ace!*



The inside of the tails of 57th Fighter Weapons Wing carried a wide Black stripe on which a stylized eagle was painted in the aircraft color.

The 33rd Tactical Fighter Wing carried a stylized eagle head on a wide Black stripe on the inside of the tail. (Wally Van Winkle)

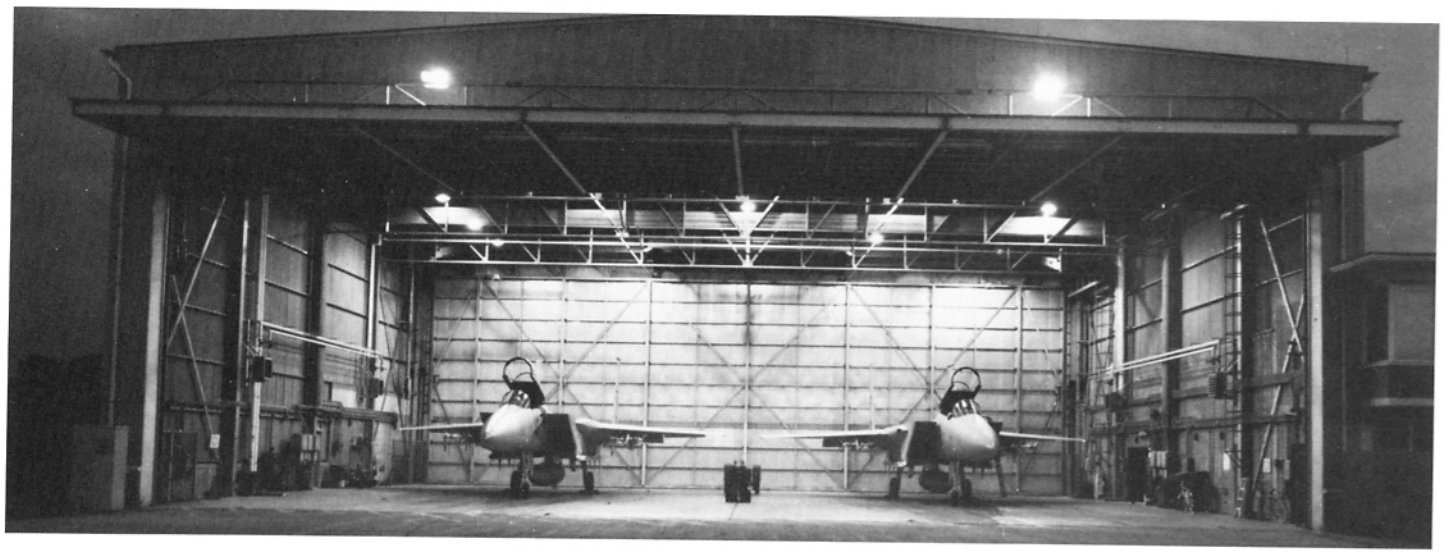


(Left) The 18th TFW 'Shogun' emblem on the inside of the tail.

(Below) The business end of the F-15's M-61 20MM six barrel cannon is buried in the leading edge of the right wing forestrake. (McDonnell Douglas)

With conformal fuel pallet tanks, the F-15E is capable of carrying a 24,500 pound payload.

F-15E Dual Role Fighter (DRF) in its element — IFR weather.



A pair of air defense mission-ready Eagles sit in their alert hangar — they can be scrambled within minutes. (McDonnell Douglas)

(Above) F-15s from the 32nd TFS bank over the canals of Holland near Soesterberg Air Base. (McDonnell Douglas)

(Below) The 32nd TFS has operated under NATO control since receiving its first Eagles on 13 September 1978. (McDonnell Douglas)

The 36th Wing applied appropriate markings in Black and Yellow to the tail of one of its Eagles for the annual USAFE Tiger Meet, a tiger's head has also been painted in Black, Yellow, and White just below the windscreen.

At a landing weight of 30,000 pounds, an F-15 will land at 130 knots on a standard day (sea level, 69 degrees Fahrenheit). It does not have a drag chute, relying on the large speed brake and aerodynamic braking to decelerate after landing. (Michel C Klaver)

(Left) 32nd TFS Eagle at Soesterberg Air Base. Rudder positions vary automatically and are controlled during flight by a mechanical rudder aileron interconnect and the Flight Control System. (Michel C Klaver)

(Below Left) Ex-32nd TFS F-15B loaded with full fuel for the long flight back to the United States, and re-assignment after having been replaced by a new F-15D.

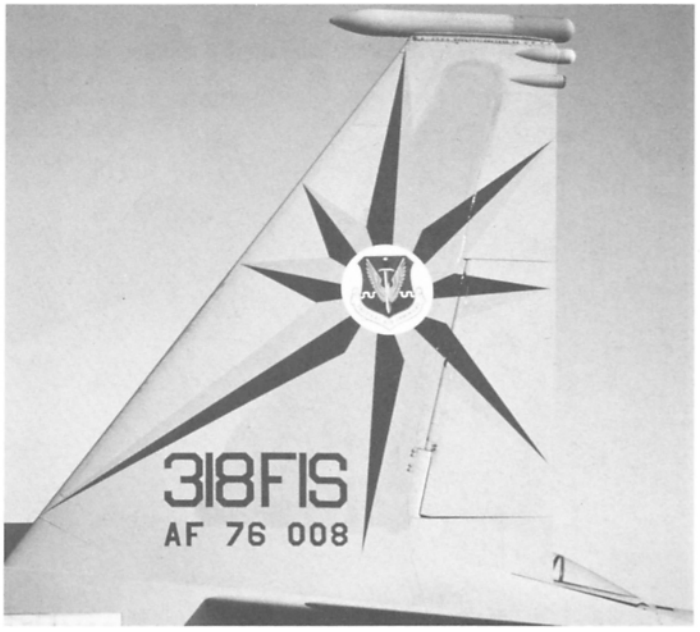
32nd TFS F-15B mounting practice Sidewinder Missile. USAFE emblem is carried below the wing just behind the air intake.

USAFE alert Eagles are maintained in hardened shelters, fully loaded with fuel and weapons. In these shelters they should be able to survive a first attack, and then be scrambled within minutes. (McDonnell Douglas)

32nd TFS alert bird scrambles during a practice mission from Soesterberg. In this configuration, the F-15 can climb to 30,000 feet in less than two minutes from brake release.

F-15As of the 318th FIS, McChord AFB, Washington. The 318th is one of three Air Defense Tactical Air Command (ADTAC) units (as of this writing) to trade in their F-106s for F-15A/Bs, which in turn had been traded in by other units for F-15C/Ds. These ADTAC F-15 squadrons will perform anti-satellite missions when ASAT becomes operational. (McDonnell Douglas)

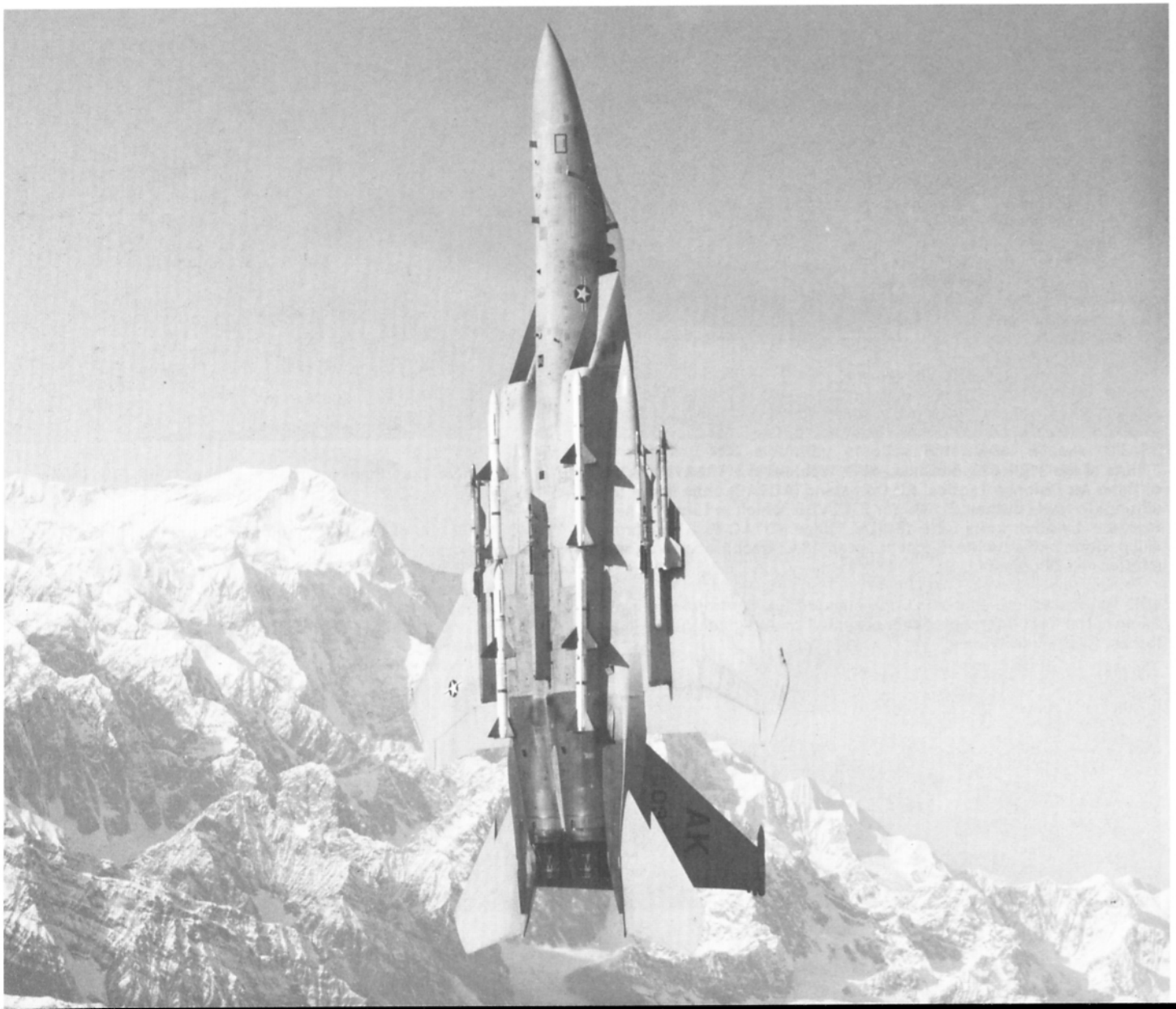
With its long range radar and sophisticated fire control system, the Eagle is the best interceptor ever operated by American Air Defense forces. (Wally Van Winkle.)

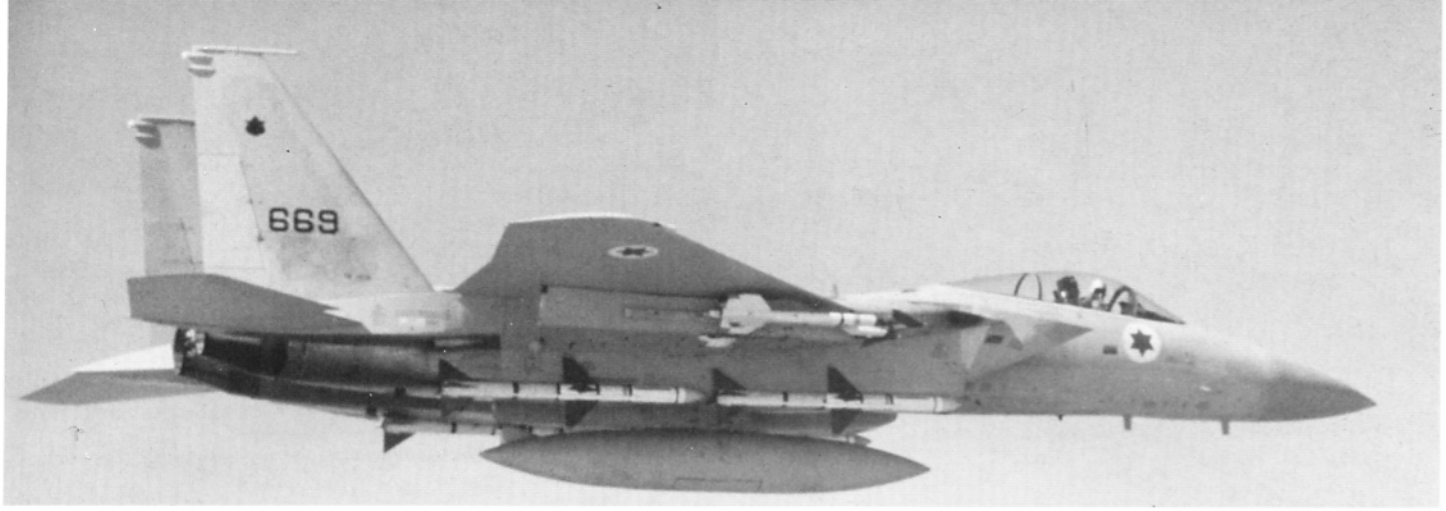


The distinctive Blue/Black starburst of the 318th FIS. (Wally Van Winkle)

The 48th FIS, one of two F-15 equipped interceptor units defending the US east coast, flies out of Langley AFB, Virginia. The other operational ADTAC F-15 unit is the 2nd FIS, at Tyndall AFB, Florida. In addition USAF has plans to activate the 325th Tactical Training Wing (TTW) at Tyndall, for F-15 interceptor training. The 5th FIS at Minot AFB, N.D., and the 37th FIS at K I Sawyer AFB, Michigan will be re-equipped with the F-15A/B. (Wally Van Winkle)

The 43rd TFS of the Alaskan Air Command turned in their F-4Es and received F-15A/Bs. (McDonnell Douglas)

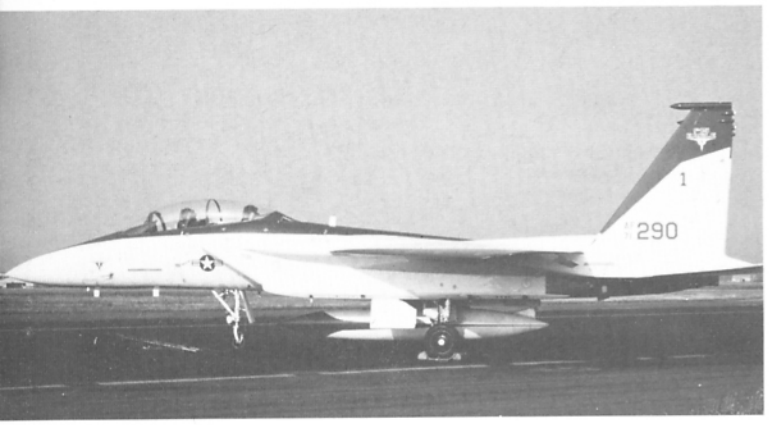




All of the F-15's combat missions have been flown in the middle east. The Israeli Air Force has used the F-15 in conjunction with F-16s and the E-2 to rack up nearly unbelievably lopsided victories against its enemies. During the Lebanon Invasion, Israeli F-15 and F-16 squadrons ran up the score against Syrian MiGs to a final over the Bekka Valley of 86 to 0. The F-15 was even able to shoot down a high flying MiG-25 with an AIM-7. F-15s also escorted the Israeli F-16s which successfully attacked Iraq's nearly completed nuclear reactor. The other middle east air force to blood the Eagle is the Royal Saudi Air Force, which used its F-15s to shoot down a pair of Iranian F-4s over the Persian Gulf on 5 June 1984. The Ayatolla's Phantoms had launched on a mission to attack an oil tanker in the gulf. The Saudi F-15s were alerted to the F-4s by a USAF E-3 AWACS, which had been sent to the middle east by President Reagan in response to the threat to tankers in the gulf. Iranian F-4s can traverse the Gulf in twelve minutes, making them a serious threat to Saudi oil fields. Both of these Phantoms were destroyed with single AIM-7s launched by a pair of Saudi F-15s. A third F-4 fled the area before it could be engaged.(McDonnell Douglas)

Pins are removed from a Sidewinder launch rail at the 'last chance' armament area, Nellis AFB, Nevada. (Dave Mason)

The only other foreign air force to operate the F-15 Eagle is the Japan Air Self Defense Force (JASDF). (McDonnell Douglas)



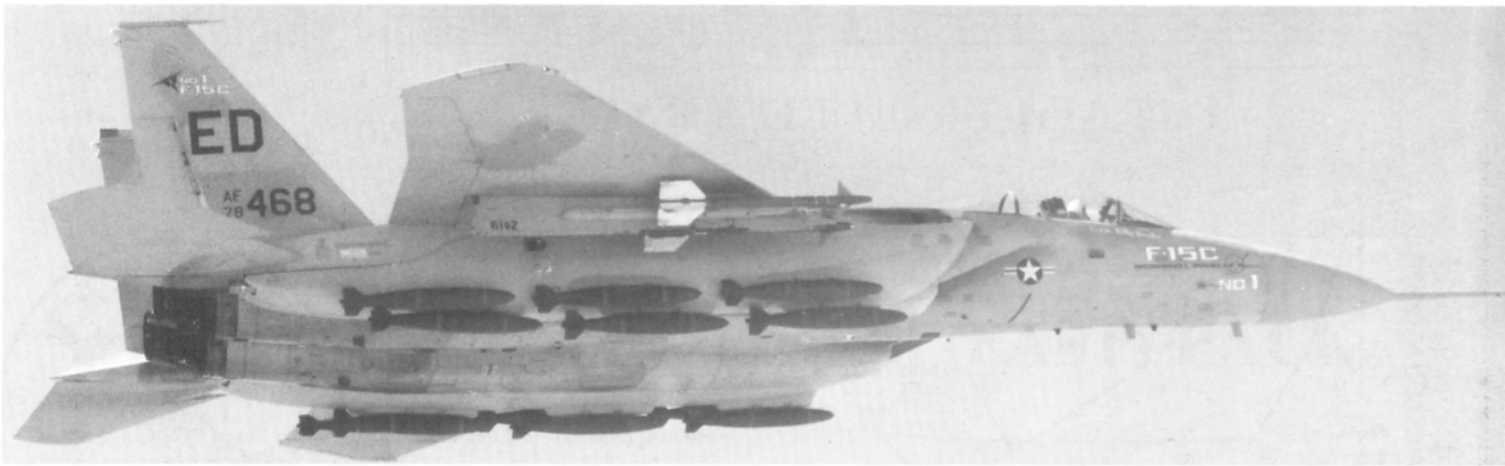
The McDonnell two seated F-15B 71-290 was also finished in this scheme during 1980. (McDonnell Douglas, Wally Van Winkle)

A recent paint scheme found on McDonnell's test aircraft is overall Gloss White with Gloss Dark Blue trim as seen on F-15A 71-289.

The number one F-15C (78-468) test firing an AIM-7 Sparrow missile off one of the launch rails on a FAST PACK fuel pallet. Although the FAST PACK fuel pallets were designed early in the F-15 project, the Air Force did not buy them until the F-15C/D models entered production. Late models of the F-15 are the only ones which can employ FAST PACKs operationally. Note cameras under the wing, and the reference marks painted on the fuselage for the test program. (McDonnell Douglas)

(Above) The first F-15C carried an instrumented test boom on the nose for the test program. (McDonnell Douglas)

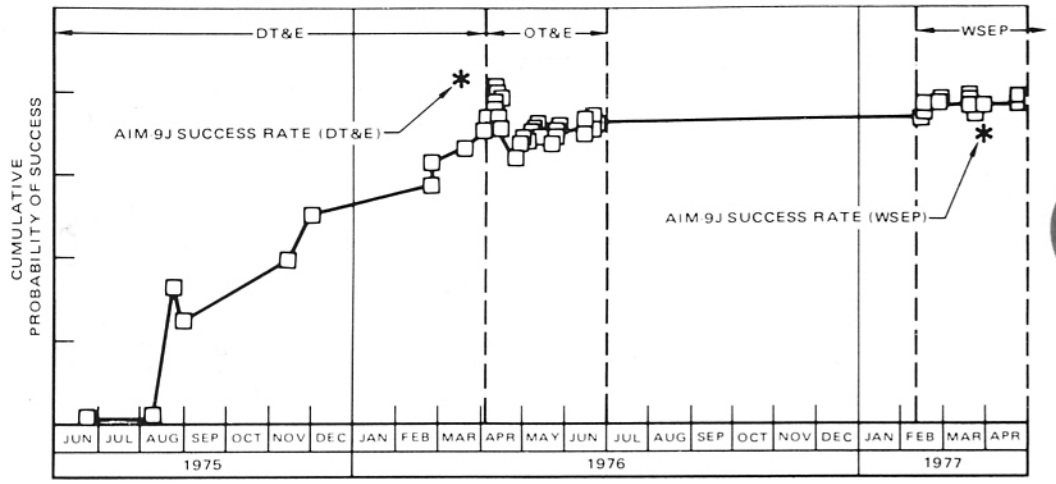
(Below) And eventually carried the ED tail code of Edwards AFB. A FAST PACK has been installed and bombs are carried on the FAST PACK pylons. (McDonnell Douglas)



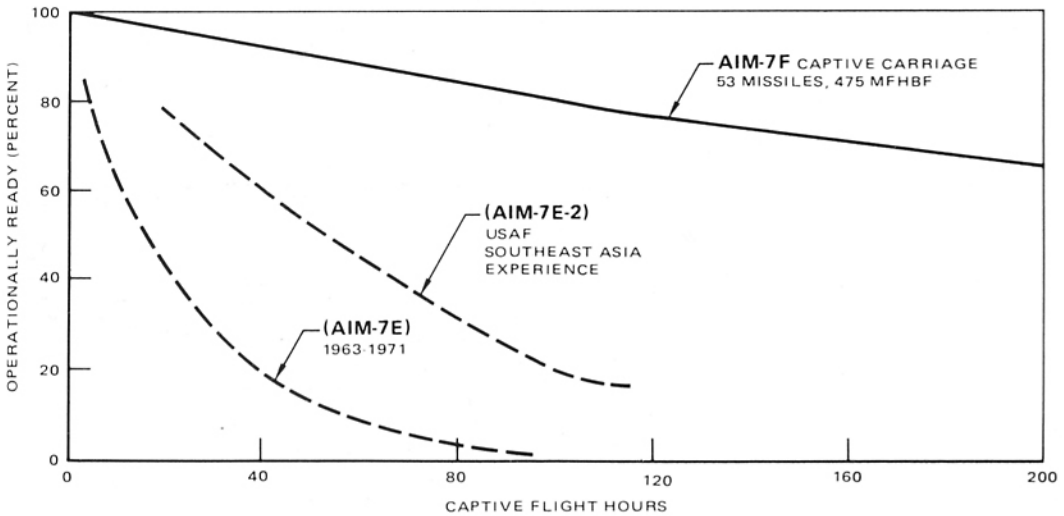
(Below) Weapons carriage on the FAST PACK pylons provide a low drag profile, enhancing the range and performance of a bomb laden F-15. (McDonnell Douglas)

F-15 WEAPONS

AIM-7

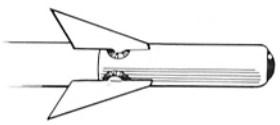

DT&E
OT&E
WSEP
CUMULATIVE PROBABILITY OF SUCCESS
AIM-9J SUCCESS RATE (DT&E)
AIM-9J SUCCESS RATE (WSEP)
JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR APR
1975
1976
1977

F-15 AIM-7F SUCCESS RATE

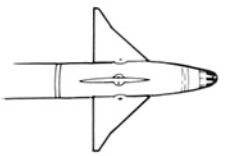


AIM-7F RELIABILITY

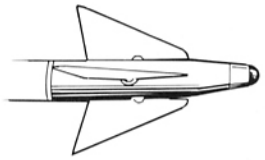
SIDEWINDERS



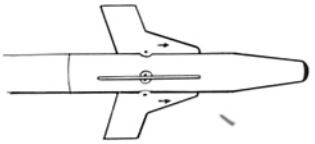
AIM-9B



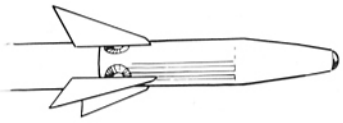
AIM-9L



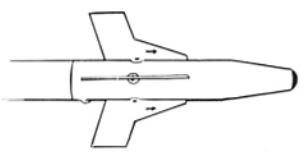
AIM-9D



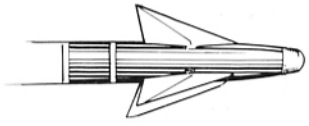
AIM-9N



AIM-9E



AIM-9P



AIM-9H

F-15D

F-15D

F-15C

Starboard Fin

ECM Tail Warning Radar

Anti Collision Light

F-15C

Pitot Tube

HUD

AOA Sensors

F-15C

Pitot Tube

UHF Antenna

ECM Antenna

TACAN Antenna

AIM-7F Sparrow

AIM-9 Sidewinder

F-15C

20mm M61A-1 Vulcan Cannon

F-15C with Fast Packs

20mm M61A-1 Vulcan Cannon

Anti-Collision Light

ECM Antenna

Refueling Receptacle

Pylon

AIM-7F Sparrow

AIM-9 Sidewinder

Gun Service Doors

Pylon

AIM-7F Sparrow

AIM-9 Sidewinder

Navigation Light

Leading Edge Dog Tooth

Low Voltage Formation Lights

Fuel Jettison Pipe

ACES II Ejection Seat

Specifications

F-15 C/D

	F-15C	F-15D
Wingspan	42 ft 9.7 ins	42 ft 9.7 ins
Length	63 ft 9 ins	63 ft 9 ins
Height	18 ft 5.5 ins	18 ft 5.5 ins
Maximum Weight	68,000 lbs	68,000 lbs
Engines	Two Pratt & Whitney F-100 PW-100	Two Pratt & Whitney F-100 PW-100
Maximum Speed		
45,000 ft	Mach 2.5	Mach 2.5
Sea Level	Mach 1.2	Mach 1.2
Combat Ceiling	65,000 ft	65,000 ft
Maximum Range		
External Tanks	2,500 miles	2,500 miles
FAST PACK	3,000 miles	3,000 miles
Crew	One	Two

1/72 Scale

By Kevin Wornkey

Pitot Tube

F-15C

20mm M61A-1 Vulcan Cannon

AIM-7F Sparrow

AIM-9 Sidewinder

Leading Edge Dog Tooth

Fuel Jettison Pipe

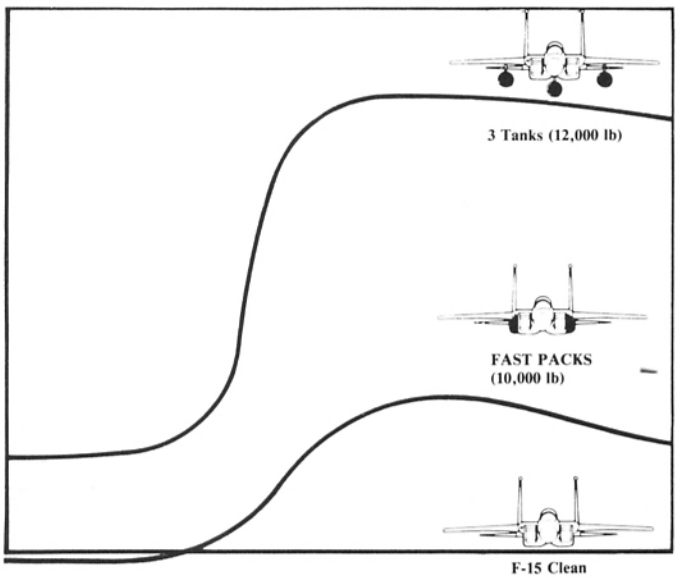
ACES II Ejection Seat

FAST PACKs have a fuel capacity of 10,000 pounds with much less drag than conventional external fuel tanks. (McDonnell Douglas)

Fuel And Sensory Tactical (FAST) PACK

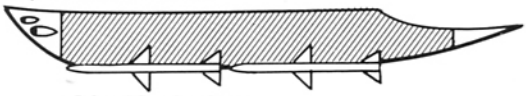
As a result of an Israeli requirement McDonnell Douglas developed conformal fuel pallets that attached to the sides of the fuselage under the wings, providing an additional 10,000 pounds of fuel with only twenty-five percent of the drag created by the 12,000 pound capacity three external fuel tank configuration (see chart). With the addition of specialized equipment these fuel pods have become known as Fuel And Sensory Tactical PACKS, or FAST PACKS, increasing the Eagle's mission capability dramatically. The PACKS can be snapped on or off of late model F-15s in a matter of minutes, increasing considerably the range, payload, and performance of the Eagle.

Relative Drag Factor



Fuel Pallet

Interceptor Systems and Fuel



- Infrared Search and Track
- Target Identification System Electro-Optical (TISEO)
- Data-Link

Reconnaissance Systems and Fuel

- Cameras
- Data-Link
- LORAN
- Photoflash

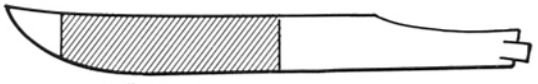
Strike-Assist Systems and Fuel

- Laser Designator
- Low Lite Level TV
- Forward Looking Infrared Radar
- LORAN

SAM Suppression Systems and Fuel

- Electronic Support Measures
- Tactical Jamming Equipment
- Chaff

Thrust Augmentation Systems and Fuel



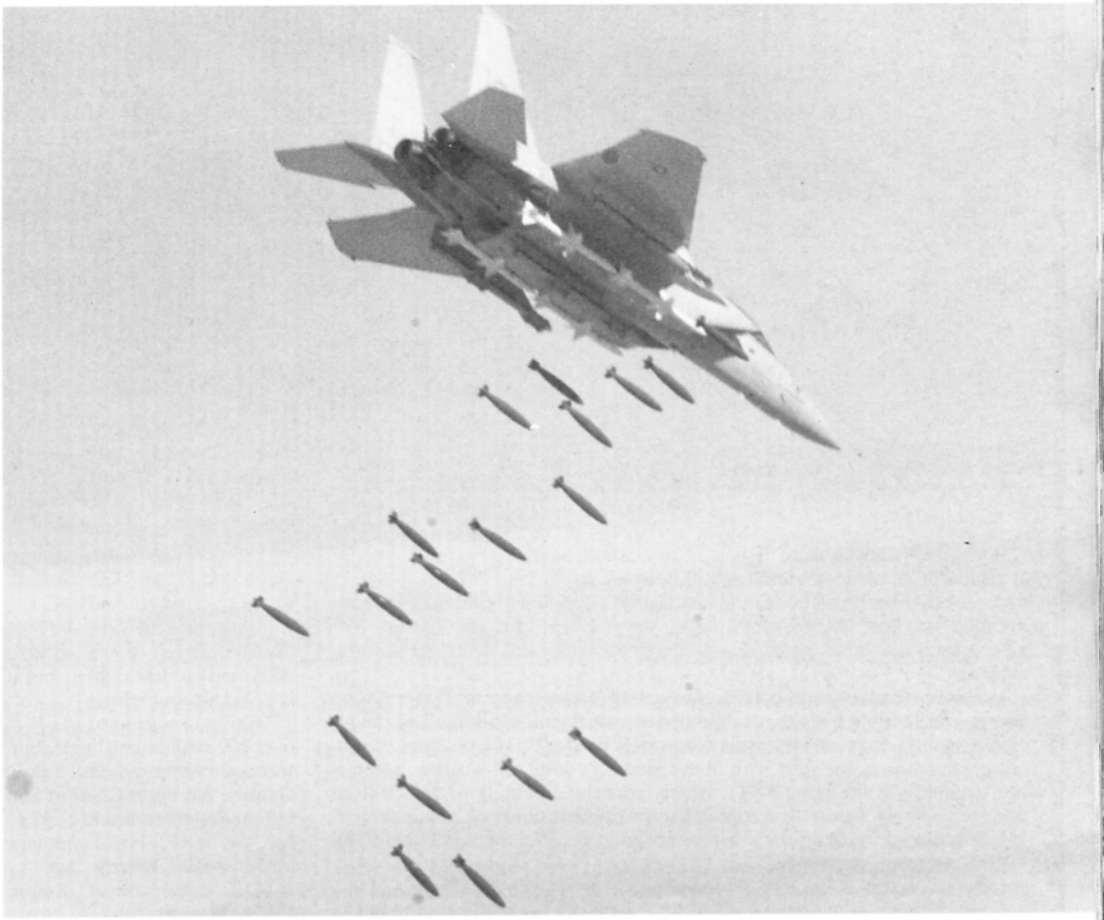
- Rocket Boost
- Precompression Cooling Tank

(Above) In spite of the hard-core fighter community, which coined the phrase 'Not a pound for air-to-ground!', during the design phase McDonnell had already proposed a wide variety of air-to-ground munitions for delivery from the Eagle, including the AGM-65 Maverick and the AGM-84 Harpoon. (McDonnell Douglas)

(Left) The antenna of the APG-63 radar can be fully exposed for maintenance. (McDonnell Douglas)

(Below) The company F-15B carried Conformal Fuel Pallets on a test flight in August of 1974. (McDonnell Douglas)

(Above) In November of 1973 the two seater, still designated TF-15, was used by McDonnell to sell USAF on the idea of hanging bombs on the best air-to-air fighter ever built. (McDonnell Douglas)



(Right) Three years later McDonnell Douglas was proving that the Eagle could be used as a bomber, delivering eighteen 500 pound bombs on this mission. (McDonnell Douglas)

The 9,000 pounds of bombs were loaded on three pylon stations, one on each wing and one on the centerline. (McDonnell Douglas)

F-15E STRIKE EAGLE

The selling of what would eventually become the 'Dual Role Fighter' involved lots of publicity photos such as this one, taken in February of 1976, with displays of conventional ordnance. (McDonnell Douglas)

When the F-15 was being designed, the champions of 'commonality' urged inclusion of an air-to-ground capability which could take full advantage of the impressive performance of the new fighter. They were repulsed by the advocates of air superiority with the cry, "Not a pound for air-to-ground!"...and the F-15 was designed as a pure air-to-air fighting machine.

However, the tremendous technological advances made in fighter design have made possible a multi-mission aircraft which will excel in all of the air combat arenas. Such an aircraft is desperately needed by USAF, since the only airplane now in the fleet with high-speed, low-level, all-weather interdiction capability is the aging F-111, which lacks the capability to defend itself against air-to-air threats. It is ironic that the prime product of 'commonality' will be replaced by an airplane whose designers resisted the very concept of.

Both McDonnell Douglas and General Dynamics recognized that their already successful designs (F-15 Eagle and F-16 Fighting Falcon) had the potential to become what was being referred to as the 'Dual Role Fighter' (DRF). Multi-stage improvement programs (MSIP) were operating for both fighters, insuring that the latest state-of-the-art changes would be made to both aircraft on an on-going basis. Both companies decided that it would be wise to develop DRF versions of their fighters, and both developed flying demonstrators which the Air Force tested extensively at Edwards AFB in 1983.

The F-16XL Scamp is a significant departure from the standard F-16. It features an enhanced aerodynamic configuration, employing a cranked arrow wing in place of the standard wing and horizontal tail surfaces of the production F-16. Two F-16XLs were built, a single seat and a tandem two seater.

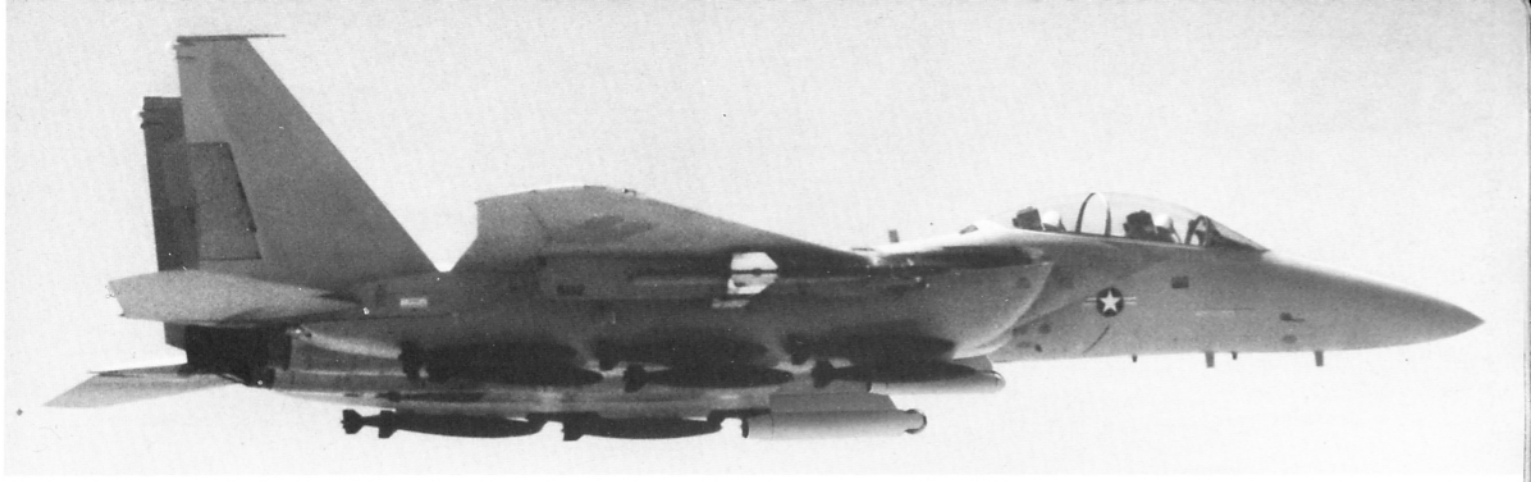
Visually, the F-15E did not differ markedly from the standard two seat version. McDonnell had opted for the two seat version, reasoning that two men would be needed to manage all of the avionics associated with the night/all weather air-to-air or air-to-ground mission. Three F-15 Eagles were employed in the test program, a standard two seat F-15D, a single seat F-15C configured with the Fast Pack conformal fuel pallets, and a two seat F-15B, each of which contained *missionized cockpits* with advanced avionics, though lacking the full system that McDonnell Douglas intended to install in a production airplane.

Both the F-16XL and the F-15E would offer great improvements in range and payload over current production airplanes, and the Air Force initially proceeded as though they intended to procure both airplanes. But the cost of the test program for the essentially *new* F-16XL militated against its selection ($470 million for the F-16XL, versus $270 million for the F-15E). The Air Force planned to develop an advanced tactical fighter for the 1990s which would replace the F-15 and F-16, and it was reluctant to spend developmental funds to stretch an existing design. The F-16XL may be the forerunner to this advanced tactical fighter, but it was not the airplane the Air Force chose for it's Dual Role Fighter.

The flight testing of the F-15 DRF was completed on 30 April 1983 after over 200 evaluation flights, but the official selection of the F-15E as the DRF was not announced until February 24, 1984. On that date General Charles A Gabriel, Air Force Chief of Staff, announced that the USAF would spend 1.5 billion dollars to modify 392 F-15s to meet mission requirements envisioned for the DRF. His announcement contained the following: *The F-15E demonstrated clearly superior dual-role mission capabilities*, while the F-16XL demonstrated *...high potential for follow-on development.* The F-15Es were expected to be acquired during the Fiscal 1986-91 time frame.

The F-15E Strike Eagle, as the DRF variant has come to be known, utilizes the existing F-15 airframe without loss of fuel capacity. It has ninety-six percent commonality of spares with the F-15C and D. The cockpit controls and displays have been redesigned and feature a wide field of view heads-up display, automated multi-purpose displays for improved navigation, weapons delivery, and systems operation. These non-dedicated displays may be utilized for many different tasks, including displays of a moving map, weapons options, precision radar mapping, terrain following, and Forward Looking Infrared (FLIR) for targeting and navigation.

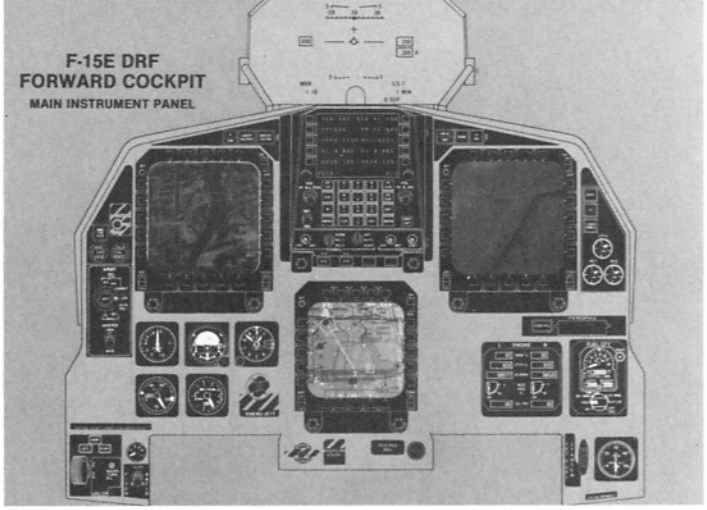
The F-15E Strike Eagle uses the standard F-15 APG-70 radar, but software additions will provide precision air-to-ground radar maps. Target detection is possible at up to 100 nautical miles and high-quality images can be obtained at ranges of over fifty nautical miles. The F-15E employs LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) pods, which provide terrain following commands, wide field of view FLIR for navigation and precise infrared images for accurate attacks at night. The conformal fuel tanks and tangental weapons carriage permit the Strike Eagle to achieve performance and payload capabilities comparable to the F-111. With minor strengthening of the wing spars, the F-15E will be certified for up to nine Gs — a major feature that the F-111 doesn't have and that prevents its crews from getting maximum benefit from low altitude high speed penetration of enemy territory. Proposed gross takeoff weight of the F-15E Strike Eagle is 81,000 lbs, giving it a 24,500 pound payload.

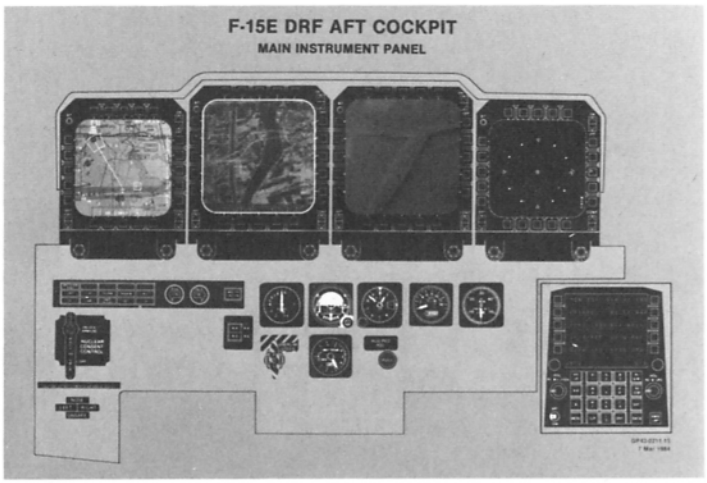


An F-15E Strike Eagle (aka DRF) with a dozen MK 82s and a pair of standard-for-the-DRF LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) pods. (McDonnell Douglas)

(Above) By 1982 71-291 had been designated the 'DRF Demonstrator', and is seen carrying the AFC Demo legend on its tail in Black. (McDonnell Douglas)

(Below) The DRF Demonstrator loaded with Rockeye anti-armor munitions taxies out for a test flight from McDonnell Aircraft Company facility at Lambert Field, St Louis in August of 1982. (McDonnell Douglas)





(Above) The F-15E designee equipped with PAVE TACK pod on the centerline which contains imaging infrared sensor, laser designator, laser-ranging receiver and stabilized sight assembly. (McDonnell Douglas)

(Above right and Right) The front and rear instrument panels in the F-15E. Note how the traditional IFR instruments have been relegated to standby status in favor of HUD, IR, moving map, and LLTV displays. (McDonnell Douglas)

(Above) St Louis 12 October 1982 — Pat Henry, MCAIR chief experimental test pilot, and Wayne Wight (right) chief systems operator, congratulate each other after 2,000 flight hours flown by AFCD demonstrator TF-2. (McDonnell Douglas)

71-291, adorned in 'European One' camouflage, was known as the 'Strike Eagle' for a short time during the competition between the F-15E and the F-16E for the DRF contract. A GBU-15 is being carried on the wing pylon.

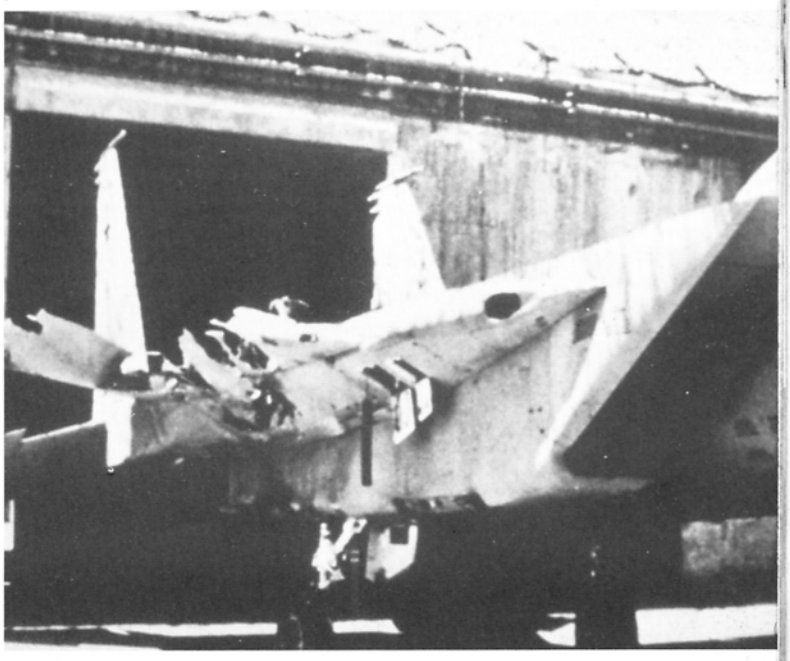
The Company demonstrator (above), and a brand new F-15D all dressed up to look like an F-15E (below). (McDonnell Douglas)

The Indestructible Eagle

I had heard the story second-hand, and in all honesty, it sounded too incredible to be true. When I contacted McDonnell Aircraft Company and asked them to confirm or deny it, they officially opted for the latter. Still, the second hand source seemed so genuine that I was inclined to believe the story, but without some kind of corroborating evidence, I didn't want to put it in print. Now, with the publication of this photo, I can repeat the story as it was told to me. Though there is no caption with the photo, and still no official acknowledgement of the details. That fact alone would seem to lend credence to this *unofficial* version, since the Israelis are so security-conscious.

The Eagle pictured is an Israeli F-15B which lost its right wing in a mid-air collision. The two pilots were divided in their opinion of how to handle the situation. The guy in back (understandably) wanted to jump out. The guy in front had already decided that the airplane was controllable, and since F-15s are a primary national resource for Israel, he decided to stick with it and try to get it back on the ground without further damage. He was able to nurse it back to base for a high speed landing that blew tires and used up brakes, but saved the airplane.

During this opus, the Israeli pilot had had to use some very imaginative and unorthodox control inputs to maintain control of the airplane. As a result, a new program has been instituted at the USAF Flight Dynamics Laboratory, aimed at allowing future Eagle pilots to fly a severely damaged aircraft. A flight control computer will reconfigure the remaining effective control surfaces to compensate for damaged or missing controls. They can be used as rudders, ailerons or flaperons, as necessary. Of course, without the interconnected control system of the F-15, this particular F-15 would have become another blackened hole in the desert. It was this system, which causes the F-15 stabilators to operate as ailerons in some parts of the flight envelope, that allowed a very smart and courageous pilot to save his Eagle in the first place.



FUTURE EAGLES

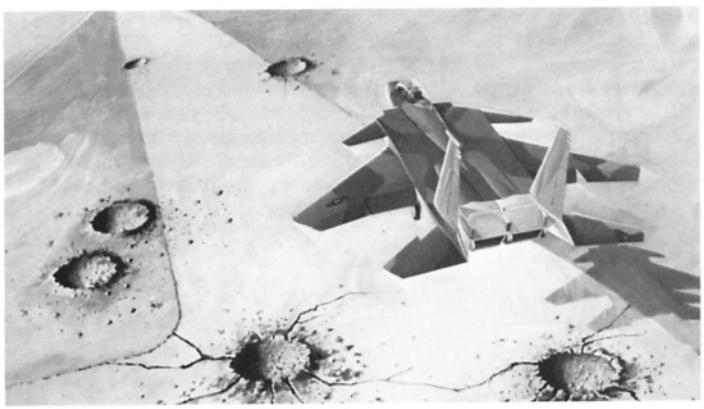
On 3 October 1984 the USAF Aeronautical Systems Division's Flight Dynamics Laboratory at Wright Patterson AFB, Ohio awarded a 117.8 million dollar contract to McDonnell Douglas to build a STOL (Short Take Off and Landing) and Maneuver Technology Demonstrator version of the F-15.

The principle features which will distinguish this prototype from other versions of the Eagle will be canards located on the shoulders of the engine intakes, and rectangular exhaust nozzles. The canards will increase lift and reduce drag at both sub-sonic and supersonic speeds. The rectangular exhaust nozzles will vector engine thrust to shorten take-off, and have reverse thrust capability to aid in braking after landing. A collateral advantage will provide for vectored thrust in air combat maneuvers.

The rectangular exhaust nozzles are officially called *two dimensional* by their manufacturer, Pratt & Whitney. P&W paid for construction of a test nozzle, and the Air Force funded ground tests which proved the validity of the concept. Because of this reverse thrust feature, it is estimated that landing distances will be reduced to one third of the current requirement for dry runways, and up to one fifth on a wet or icy runway! (Reduced from 3,000 feet to 1,000 feet of dry pavement and from 10,000 feet to 1,200 feet on the wet pavement.) Inflight vectoring of the nozzle will greatly enhance maneuverability through decreased turning radius, acceleration and deceleration.

The two dimensional nozzle is not exactly a new concept. Pratt & Whitney has been exploring the concept since at least 1973, and while it is considerably cheaper to produce than a round nozzle, it also adds several hundred pounds to the weight of the engine. That weight has now been more than compensated for by the demonstrated advantages of the new nozzle. The reverse thrust feature eliminates the need for a speed brake, which will save weight. The relatively complex controls of the nozzle will be a part of the F-15's new digital fly-by-wire control system, which will integrate flight control, engine, and steering and braking functions. The P&W two dimensional nozzle is the only one of its kind in the world and differs from the vectored thrust nozzles of the Harrier in that it is capable of supersonic flight.

Future F-15s will be capable of flying steeper approaches to uncharted runways through the use of radar, infrared, and inertial navigation systems, which will locate the runways and generate guidance cues for the pilot. This has necessitated modification of the landing gear to withstand high-sink rate landings on rough runways. Modification of the test aircraft, at McDonnell Aircraft in St. Louis, is scheduled for completion in 1988. The Air Force will complete a thirteen month flight test program at Edwards AFB in 1989.



SIMULATORS

One of the by-products of the miniaturization of electronics fostered by the space program has been more reliable and sophisticated avionics in smaller packages. Flight computers control stick 'feel', which makes seat of the pants flying more predictable. This allows the pilot to concentrate on weapons delivery. But implementation of all the whiz-bang instruments of destruction carried by a modern fighter requires a great deal of skill and savvy, both of which can be acquired through the use of another by-product of the computer revolution.

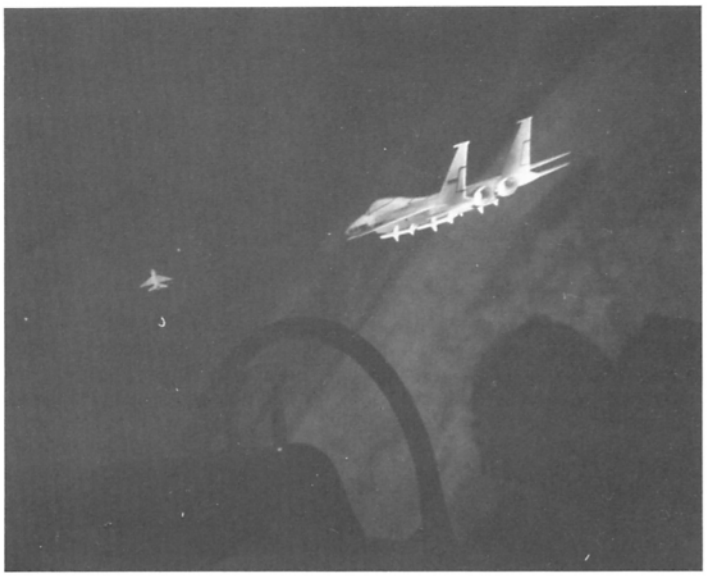
Computer generated imagery has made possible the real-time simulation of virtually all phases of the fighter mission, from take-off to low-level navigation and weapons delivery, air-to-air combat, and finally, instrument let down and landing. The simulators that fighter pilots 'fly' today are exact replicas of the aircraft cockpit. The heart of the simulator is a powerful minicomputer that provides accurate control 'feel' for the situation, while sensing control inputs and generating appropriate sensory cues on a global screen surrounding the simulator. F-15 pilots at Luke AFB can even hassle with each other via simulators that are linked by interconnected visual systems!

I did not get the chance to fly one of these marvels, but on a trip to NAS Meridian, Mississippi, I was left alone with one of their T-2 Buckeye simulators. This was a pure instrument trainer, capable of providing some sensory input in the form of motion and noise, but with no visual cue other than what you see on the panel. Since I had no flight gear, I was denied the thrill of experiencing an instrument catapult shot (a rule that has been in effect since one of the simulators was actually launched off of it's hydraulic arms and into the concrete block wall of the simulator building, is that they will not allow cat shots unless harness and hard hat are worn). After thirty minutes or so of playing with the Buckeye simulator, I was able to do loops, Immelman turns, rolls, and instrument approaches without crashing. Without the motion turned on, it was difficult to complete maneuvers such as a loop, since I was deprived of the sensory inputs of the wide G variation normally encountered (plus 4 and 0 G). This really was an instrument maneuver, the primary instruments being the attitude indicator, accelerometer, and angle of attack indicator. With the motion turned on, the student is treated to healthy doses of vertigo, and if he should happen to lose it and crash, the event will be announced to everyone within earshot by the strident whooping of a crash horn. This type of simulator can acheive a high degree of realism as far as pure 'hard IFR' instrument flying is concerned, but it cannot train pilots in some of the more difficult VFR tasks, such as air-to-air combat or low level navigation.

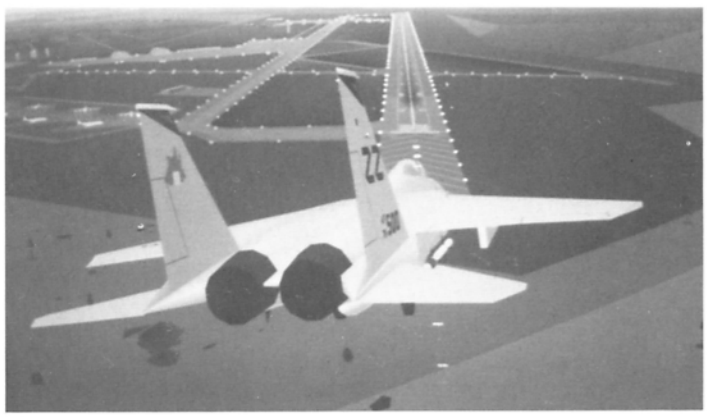
The rationale for developing extremely complex and costly simulators to acheive training for what are essentially VFR missions is the relative cost of flying it in a simulator, or flying it for real. Experience has shown that it costs about 1/10th as much to fly it in a simulator. These missions are also relatively dangerous and practicing with real airplanes flying close to real ground can add (drastically) to mission costs. Flying the new simulators, pilots can experience the visual cues they will see in flying the real missions, relating them to instrument and avionics displays. This dramatically reduces the sensory overloads normally associated with complex maneuvers which are compressed into seconds or milleseconds. One of the first things a flight instructor will tell his students is that they have to be able to 'stay ahead of the airplane'. That means knowing what to expect from certain situations and control inputs. The quickest, cheapest, most effective way to do this is with these new, total mission, simulators.

(Below) This was the computer-generated imagery seen in experimental 1974 testing of an air-to-air simulator. (McDonnell Douglas)

(Above) USAF pilots fly a mission in the F-15E against a pair of MiG-23s in the simulator. (McDonnell Douglas)



(Below Left and Below) Though not 'photographically real' yet, simulators such as the Rediffusion Simulation CT5-A system now provide imagery and movement that is realistic enough to provide excellent training for VFR missions. (Evans and Sutherland)



EAGLE Update — 1992

It has been seven years since the original version of *EAGLE* was published. During that time, the F-15 has more than proven the vision of its designers, becoming one of the world's best air-to-air fighters. In the long range interdiction role, the F-15E Strike Eagle proved to be a deadly nocturnal raider, capable of pinpoint navigation and targeting, regardless of the time of day or weather. All the superlatives I used in the original version were justified ... and then some.

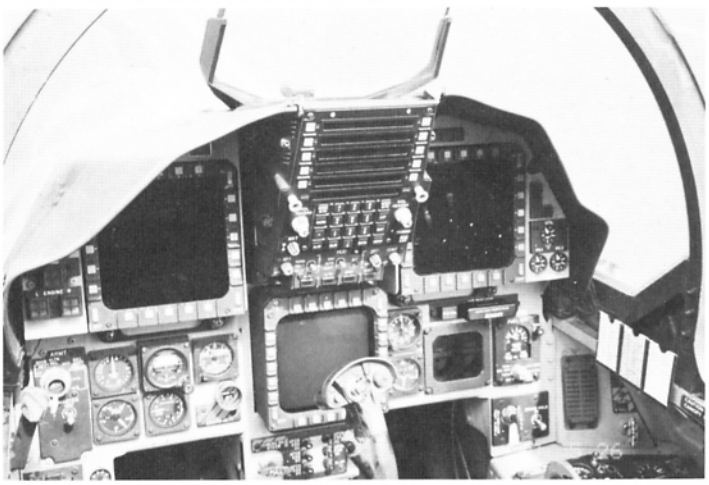
While the F-15 has catapulted American technology to the forefront of worldwide military aviation, it has also enabled American military tacticians to validate the training programs undertaken since the end of the Vietnam War. Used in conjunction with E-3 AWACS and JSTARS surveillance aircraft, the F-15 became what the F-4 Phantom had been intended to be — a true Beyond Visual Range (BVR) missile shooter. Many of the Eagle air-to-air kills during Operation DESERT STORM were achieved with the AIM-7 Sparrow radar guided air-to-air missile (whose basic design predates the F-4) at long ranges. The F-15E Strike Eagle was a night raiding predator which used JSTARS as its nose to sniff out enemy road activity, particularly mobile SCUD missile launchers. Once located, the Strike Eagle used its own state-of-the-art avionics to destroy the target. During the war, hundreds of Iraqi tanks, trucks, and Scud missiles fell prey to the Strike Eagle.

Today, the Eagle remains the cutting edge of USAF tactical air power, both air-to-air and air-to-ground.

The Short Takeoff and Landing Maneuver Technology Demonstrator (S/MTD) made its first flight with movable canards and digital fly-by-wire controls on 7 September 1988. This was followed by its first flight with thrust reversing/vectoring engine nozzles on 10 May 1989. The S/MTD program was managed by the Flight Dynamics Laboratory of the Wright Research and Development Center, Wright-Patterson AFB, Ohio. The prototype (F-15B 71-290) had also served as the F-15E demonstrator and retained much of the F-15E proof-of-concept instrumentation. (McDonnell Douglas)

The first production F-15E Strike Eagle made its first flight from Lambert Field, St. Louis on 11 December 1986. It was fitted with LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) pods and was powered by a pair of F-100-220 turbofan engines with digital electronic fuel controls. (McDonnell Douglas)

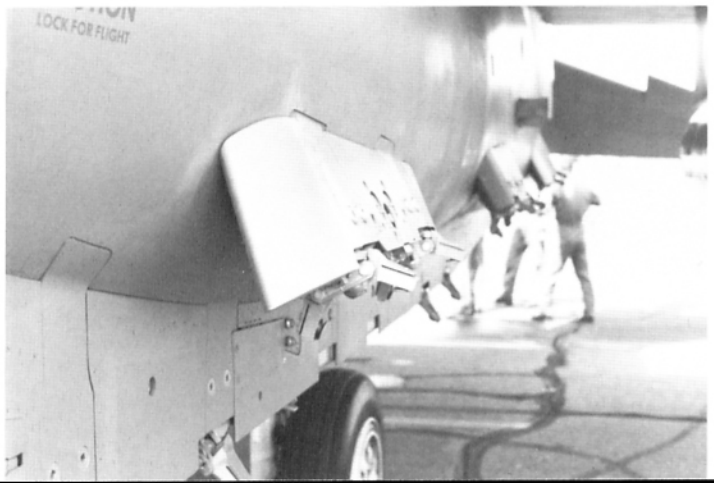
Sixty percent of the original F-15 airframe was redesigned to accommodate the mission requirements of the F-15E Strike Eagle. The heart of the weapons system is the new APG-70 high resolution synthetic aperture radar, combined with Martin Marietta AN/AAQ-14 LANTIRN and FLIR pods. (McDonnell Douglas)



The F-15 pilot's cockpit utilizes CRT displays that show weapons status, provide navigation data, and duplicate flight instruments. The HUD (Head Up Display) is in the center of the panel and there are barometric instrument backups for VSI and altimeter (located under the left CRT).

The Weapons Systems Operator (WSO) cockpit has a battery of CRT displays for navigation, radar and weapons status displays. (Dave Mason)

The FAST pack conformal fuel pallets feature three stub weapons pylons for the carriage of standard NATO air-to-ground weapons. The sway braces on the stub pylons are unique to the F-15E. (Dave Mason)



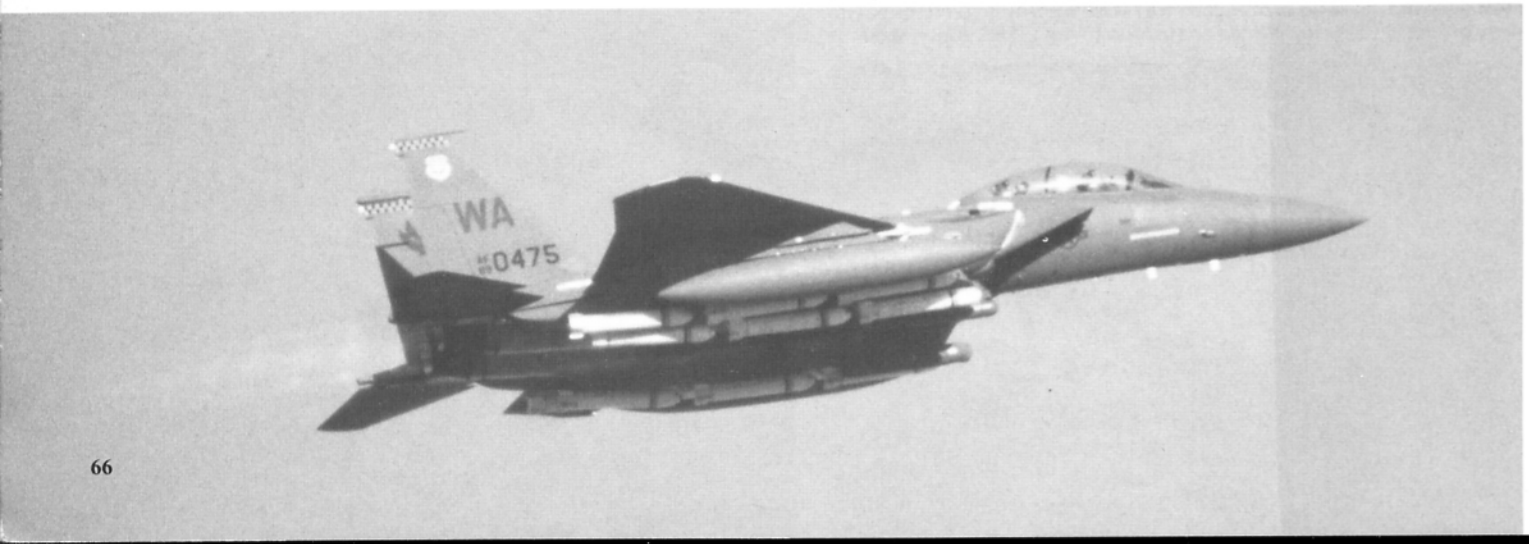
Another major difference between the F-15E Strike Eagle and earlier F-15 variants is the new, larger wheels and tires. These are needed to accommodate heavier gross weights of the F-15E's weapons payloads. (Dave Mason)

A pair of heavily loaded Strike Eagles of the 405th Tactical Training Wing, Luke AFB, Arizona, break left and right. The 550th TFTS and the 461st TFTS make up the 405th TTW and provide training for operational F-15E crews. (USAF)

While the "Turkey Feathers" (jet exhaust vanes) have been removed from all USAF F-15s, only the Strike Eagle had the fairing between the jet exhausts removed. The arresting hook has also been strengthened to handle the increased gross weight. (Dave Mason)

Ground crewmen prepare an F-15E Strike Eagle of the 4th Tactical Fighter Wing at Seymour Johnson AFB, for another mission. The 4th TFW had three Strike Eagle squadrons: two deployed to Saudi Arabia during the Gulf war, while the third remained behind as a training unit and reserve. (USAF)

An F-15E of the 57th Fighter Weapons Wing takes off and blazes away from Nellis AFB, Nevada, for a practice mission on 31 January 1991. The 57th FWW is tasked with developing the tactics for the Strike Eagle. This Eagle was loaded with Rockeye CBUs, a preferred weapon for SCUD missile hunting missions — which were being flown half a world away from Nellis. (Ted Carlson)



This F-15A belongs to the Commanding Officer of the Air Defense Weapons Center, Tyndall AFB, Florida. Not surprisingly, the F-15 Eagle has assumed much of the Air Defense Command's mission, replacing the F-106 Delta Dart in the CONUS air defense role. (Shinichi Ohtaki)

An F-15C Eagle of the 18th Tactical Fighter Wing, based at Kadena AB, Okinawa, demonstrates a full deflection aileron roll during a flight demonstration. The Eagle is one of the most maneuverable fighters in the world today. (Shinichi Ohtaki)

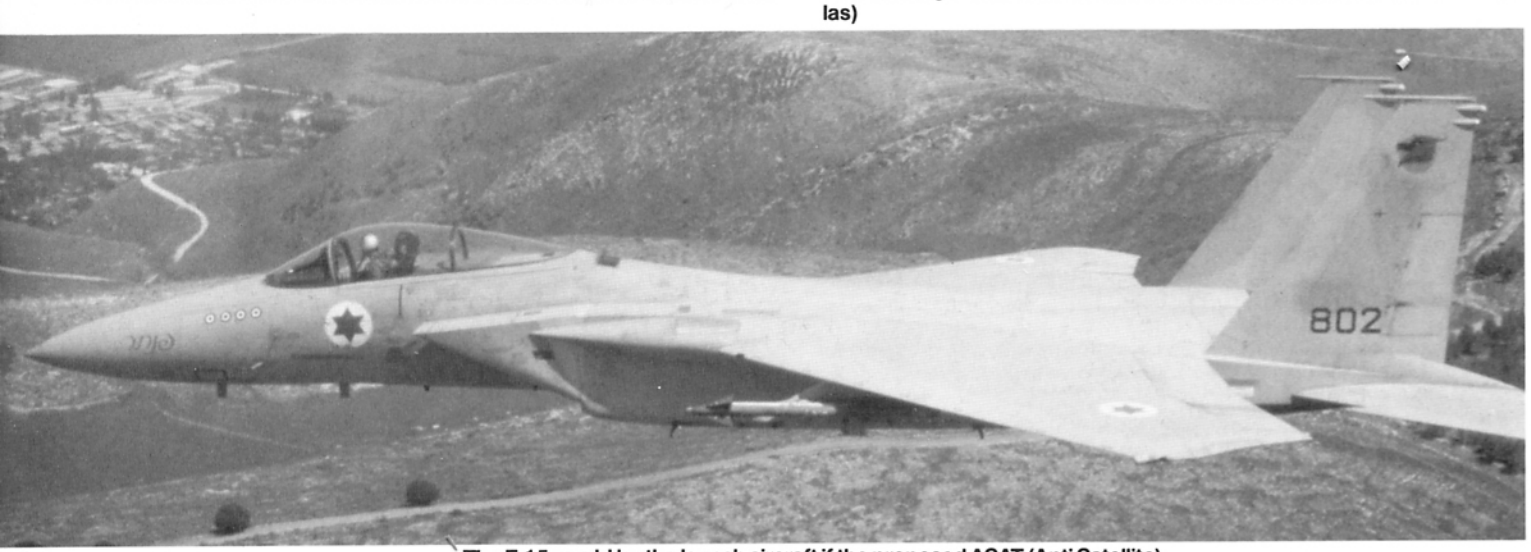
An F-15DJ of the 204th Squadron, 7th Air Wing, Japanese Air Self-Defense Force, based at Hyakuri Air Base, Japan. Japan has planned to purchase a total of 187 F-15Js and DJs, 173 of which were to be license-built in Japan by Mitsubishi. The first Japanese Eagle was delivered to Edwards AFB during July of 1980 and was flown to Japan the following March. (Shinichi Ohtaki)

An F-15C Eagle of the 43rd Tactical Fighter Squadron, out of Elmendorf AFB, Alaska, escorts a Soviet Su-27UB Flanker C trainer through Alaskan airspace. The Flanker, along with a single seat Flanker B and a supporting transport, was enroute to airshows in Canada and the United States. (USAF)

This F-15C-25-MC (79-0041) of the 43rd Tactical Fighter Squadron is parked on the ramp at Tyndall AFB, Florida. The aircraft deployed to Tyndall for the William Tell Weapons Meet which was held on 17 October 1988. Not surprisingly, the F-15 has dominated the William Tell competition since its introduction into service in the air defense mission. (Norm Taylor)

This F-15C-29-MC (80-0045) of the 57th Fighter Interceptor Squadron, based at Keflavik AB, Iceland, also deployed to Tyndall AFB for William Tell. The insignia on the inside of the vertical tail is an outline of Iceland with an Eagle's head superimposed on the island. Checkerboard tail bands have been used on 57th FIS aircraft for decades. (Norm Taylor)

One of the most successful combat operators of the F-15 is the Israeli Defense Force - Air Force, which used a combination of F-15s and F-16s to dominate the skies over Lebanon during 1983, knocking down over eighty Syrian aircraft without a loss. F-15s accounted for fifty-six kills and this Eagle carries four kill markings on the nose. (McDonnell Douglas)



The F-15 would be the launch aircraft if the proposed ASAT (Anti Satellite) missile system became operational. ASAT was designed to shoot down orbiting satellites. The seventeen foot missile would use a SRAM booster as the first stage and an Altair III rocket as the second stage. The missile has terminal IR guidance and carries no warhead — destroying its target by the force of the impact. (USAF)

F-15 GULF WAR AERIAL VICTORIES

DATE	UNIT TFW/TFS	ACFT	SERIAL	TYPE	WEAPON
JAN					
17	1/71	F-15C	83-0017	Mirage F.1	AIM-7M
	33/58	F-15C	85-0105	2 Mirage F.1	AIM-7
	33/58	F-15C	85-0107	MiG 29	AIM-7
	33/58	F-15C	85-0119	MiG-29	AIM-7
	33/58	F-15C	85-0125	MiG-29	AIM-7
19	33/58	F-15C	85-0099	MiG-25	AIM-7
	33/58	F-15C	85-0101	MiG-25	AIM-7
	33/58	F-15C	85-0114	MiG-29	GROUND
	33/58	F-15C	85-0122	MiG-29	AIM-7
	36/32	F-15C	79-0021	Mirage F.1	AIM-7
	36/525	F-15C	79-0069	Mirage F.1	AIM-7
26	33/58	F-15C	85-0104	MiG-23	AIM-7
	33/58	F-15C	85-0119	MiG-23	AIM-7
	33/58	F-15C	85-0114	MiG-23	AIM-7
27	4/36/53	F-15C	84-0025	2 MiG-23	AIM-9
	4/36/53	F-15C	84-0027	MiG-23	AIM-7
				Mirage F.1	AIM-7
28	36/525	F-15C	79-0022	MiG-23	AIM-7
29	33/58	F-15C	85-0102	MiG-23	AIM-7
FEB					
2	36/525	F-15C	79-0074	Il-76	AIM-7
6	4/36/53	F-15C	79-0078	2 MiG-21	AIM-9
	4/36/53	F-15C	84-0019	2 Su-25	AIM-9
7	33/58	F-15C	85-0102	2 Su-7/17	AIM-7
	33/58	F-15C	85-0124	2 Su-7/17	AIM-7
	36/525	F-15C	80-0003	Helo	AIM-7
11	36/525	F-15C	79-0048	Helo	AIM-7
	36/525	F-15C	80-0012	Helo	AIM-7
20	36/525	F-15C	84-0014	Su-22	AIM-9
22	36/53	F-15C	84-0010	Su-22	AIM-9
	36/53	F-15C	84-0015	PC 9	AIM-9
RSAF					
24 Jan	13 Sqn	F-15C	Al-Shamrani	2 Mirage F.1	AIM-9

Forty-eight F-15E Strike Eagles of the 4th Tactical Fighter Wing, based at Seymour Johnson AFB, deployed to Thumrayt Air Base in the Sultanate of Oman for Operation DESERT SHIELD/DESERT STORM. This F-15E is armed with CBUs and AIM-9 Sidewinder missiles. (USAF via Norm Taylor)

Coalition forces in Desert Storm were faced with the very real possibility that the Iraqis would use chemical weapons. This possibility was not unforeseen by USAF planners and all personnel were issued and practiced in protective chemical suits. (McDonnell Douglas)

4th TFW F-15Es worked with Joint Surveillance Target and Attack Radar System (JSTARS) EC-135s to locate mobile SCUD missile launchers. Once directed against a mobile launcher, the F-15Es used their LANTIRN pods to target and deliver laser guided bombs to destroy these "needle in a haystack" targets. (David F. Brown)

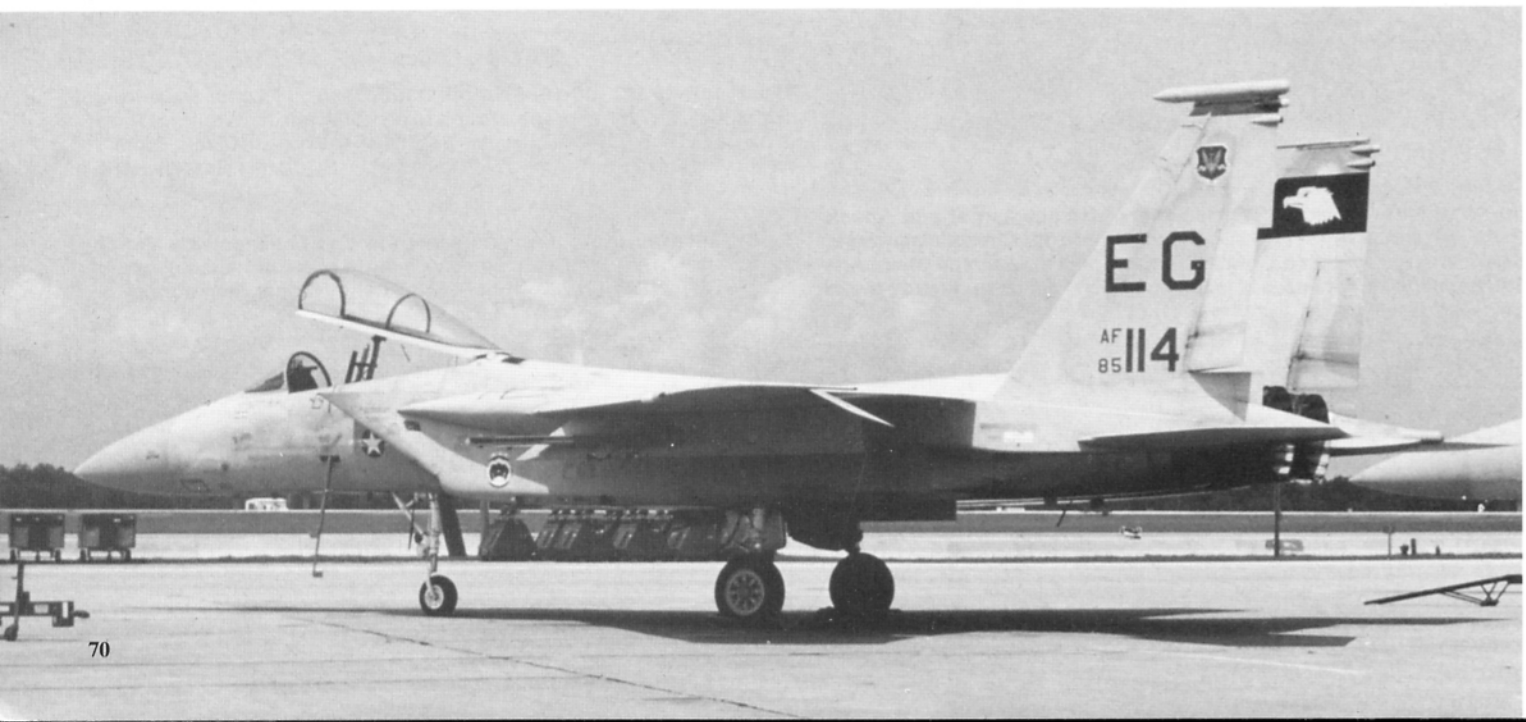
This F-15E-45-MC (88-1686) of the 335th Tactical Fighter Squadron, 4th Tactical Fighter Wing, flew fifty-two bombing missions during Operation DESERT STORM and carries its tally on the nose in Black. Primary targets for the night-flying F-15Es were mobile SCUD missile launchers. (Norm Taylor)

F-15E, serial 87-0178, was marked as the wing commander's aircraft for the 4th TFW. Strike Eagles averaged a mission capable rate of 95.9% during DESERT STORM — significantly higher than normal peacetime averages. (David F. Brown)

By 22 May 1991, the 4th TFW Wing Commander was flying a different F-15E (serial 89-0499). This aircraft was also marked as the commander's aircraft. The 4th TFW lost two F-15E Strike Eagles during DESERT STORM. Both occurred during the first three days of the war. (Norm Taylor)

The 33rd Tactical Fighter Wing was the most prolific MiG (and Sukhoi) killing unit in DESERT STORM. The main gate of their home base at Eglin AFB, Florida, has this sign that makes sure visitors know of their record! (David F. Brown)

CAPT "Rico" Rodriquez of the 58th TFS, 33rd TFW used this F-15C (serial 85-114) to score two MiG kills. He knocked down a MiG-29 by forcing it into the ground on 19 January, and blasting a MiG-23 with an AIM-7 on 26 January. The aircraft carries two Iraqi flags as kill markings under the cockpit. (David F. Brown)

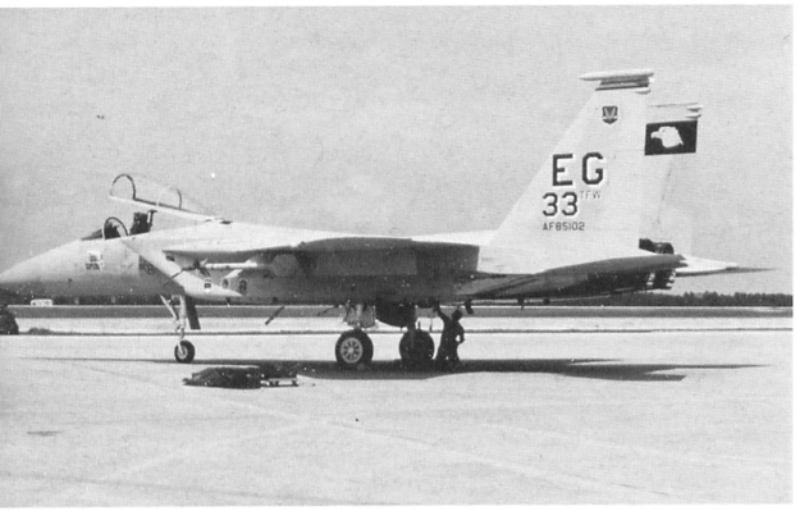


A pair of 33rd Tactical Fighter Wing F-15Cs fly formation with a Northrop F-5E Tiger II of the Royal Saudi Air Force. RSAF F-5Es saw service as fighter-bombers over Kuwait and at least one aircraft was lost in combat. (USAF).

The Royal Saudi Air Force (RSAF) also flew F-15Cs. This RSAF Eagle slides out after taking on fuel from a USAF tanker. RSAF F-15Cs flew combat air patrols and one RSAF pilot, CAPT Ayhed Salah Al-Shamrani, of the 13th FS, 3rd FW, RSAF, scored two kills, downing two Exocet air-to-surface missile armed Iraqi Mirage F.1 fighters over the Gulf. (USAF)

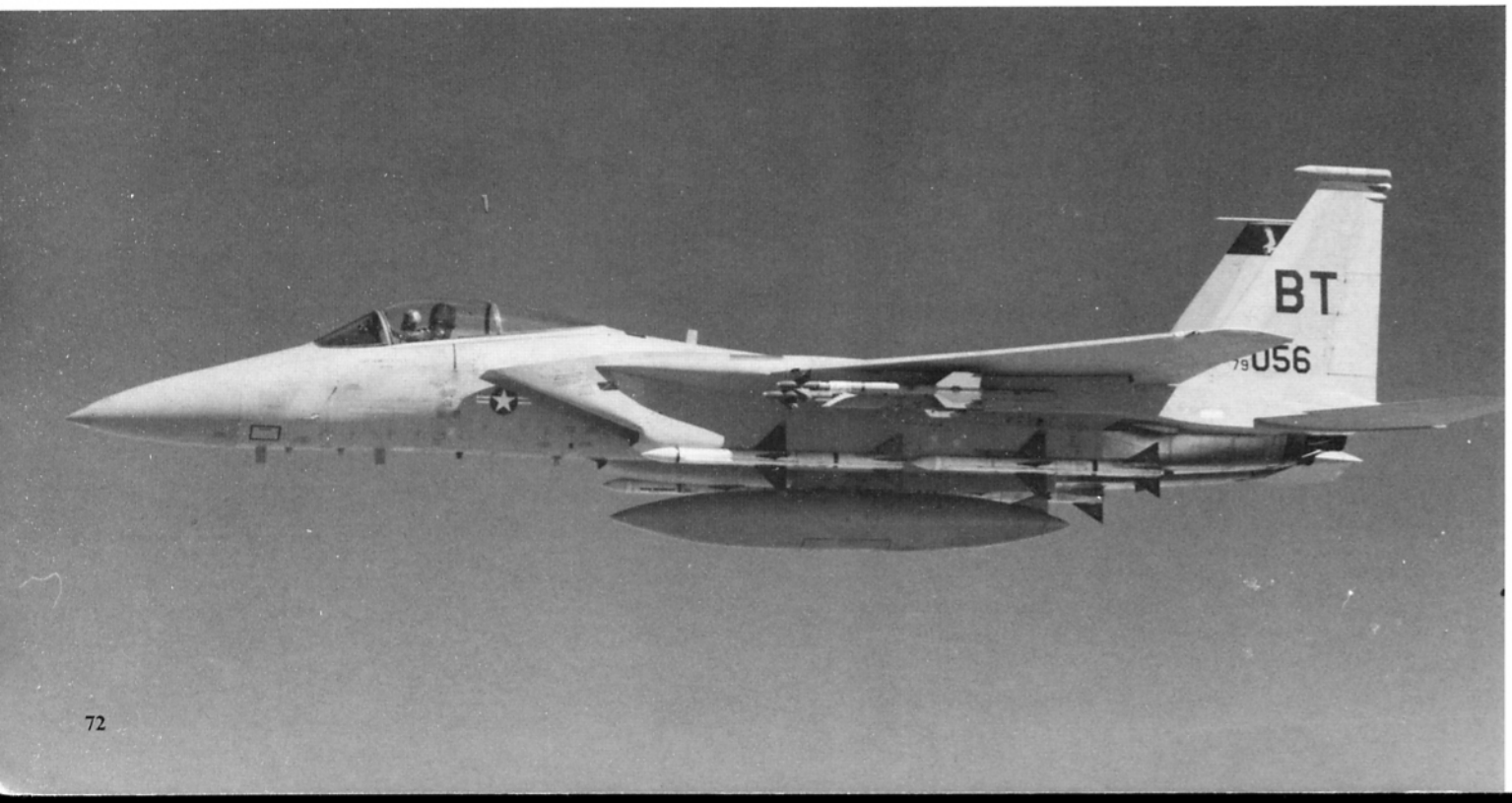
A pair of F-15C Eagles of the 36th Tactical Fighter Wing, 53rd Tactical Fighter Squadron over Saudi Arabia. F-15s performed long range MiG sweeps, searching for enemy fighter activity over Iraq. Whenever enemy aircraft were encountered, the F-15s emerged the victor. (USAF)

The first kill of DESERT STORM was credited to an F-15C Eagle of the 1st Tactical Fighter Wing, when CAPT Steve Tate shot down a Mirage F.1 with an AIM-7 Sparrow on the first night of the war. It was the only kill scored by the 1st TFW during the war. (David F. Brown)



This F-15C, marked as the 33rd TFW Wing Commander's aircraft, carries the name *GULF SPIRIT* on the nose. The Eagle, flown by two different pilots, scored three Iraqi kills: a MiG-23 was shot down by CAPT David Rose on 27 January, and two Su-17 Fitters were shot down by CAPT Anthony R. Murphy on 7 February. No F-15C/Ds were lost during the war, even though they flew some 5,900 sorties. (David F. Brown)

The 53rd TFS, 36th TFW, based at Bitburg Air Base, Germany, was the second most successful MiG killing unit in DESERT STORM. The unit scored against everything from helicopters to MiGs and Mirages. (USAF via Norm Taylor)



CAPT Ben Powell of the 53rd TFS, engages two fleeing Iraqi Air Force fighters with air-to-air missiles. The MiG-23 and Mirage F.1 were attempting to reach the safety of Iran, but were intercepted and destroyed by CAPT Powell.

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